CALIFORNIA'S MANUFACTURING INDUSTRIES:

EMPLOYMENT AND COMPETITIVENESS *in the 21st Century*

JUNE 2014

INSTITUTE FOR APPLIED ECONOMICS
Los Angeles County Economic Development Corporation

CALIFORNIA'S MANUFACTURING INDUSTRIES:

EMPLOYMENT AND COMPETITIVENESS IN THE 21ST CENTURY

Institute for Applied Economics
Los Angeles County Economic Development Corporation
444 S. Flower Street, 37th Floor ◆ Los Angeles, CA 90071
(888) 4-LAEDC-1 ◆ www.LAEDC.org

Christine Cooper, Ph.D.
Shannon M. Sedgwick
Somjita Mitra, Ph.D.

June 2014

This research was commissioned by California Manufacturing Technology Consulting.

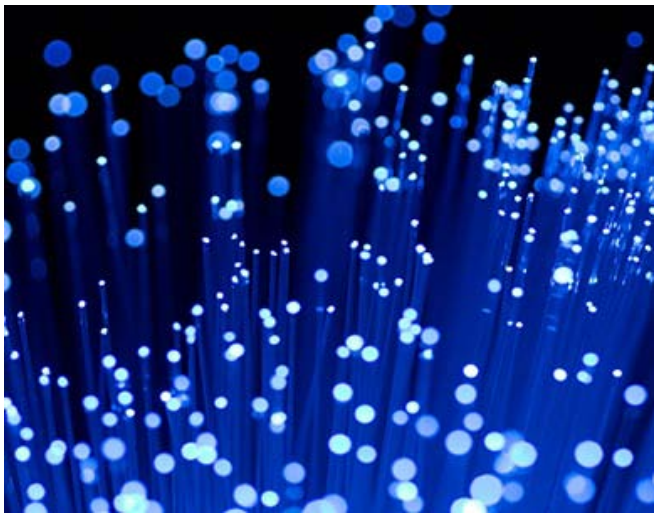
The LAEDC Institute for Applied Economics provides objective economic and policy research for public agencies and private firms. The Institute focuses on economic impact studies, regional industry analyses, economic forecasts and issue studies, particularly in workforce development, labor market analysis, transportation and infrastructure.

Every reasonable effort has been made to ensure that the data contained herein reflect the most accurate and timely information possible and they are believed to be reliable.

Table of Contents

1 Manufacturing Today—and Tomorrow

The history of manufacturing is a story of change. From the earliest industrial process innovation of mechanizing the manufacture of textiles with power generated by a centralized mill in 18th century England, to the computer-aided shop floor of today's modern factory, manufacturing has always been in a constant state of change, driven by entrepreneurs and dreamers who seek better methods, more cost-effective processes, push the boundaries of knowledge and technology of the time—ever in search of a competitive edge and never timid in applying discoveries from other fields to the problem at hand. Today's manufacturing is a testament to the innovative and disruptive thinking of generations past, and a stepping stone for generations of the future.



Innovation ….

Manufacturing is fundamentally a *process of transformation*, of building and producing stuff. But the manufacturing industry itself is, and has been, undergoing its own transformation. The transformation of manufacturing in the 20th century has been driven by three revolutionary innovations: advances in material sciences, the explosion of computing power and globalization.

The first innovation broadened the universe of inputs into manufacturing, and the understanding of how materials respond under adverse environmental conditions, and the development of new materials to overcome the limitations of existing materials. The science itself used insights from chemistry and biology, metallurgy and mining to understand and test properties of materials. More materials are being studied and analyzed and mathematically modeled every day, to be added to the database of potential inputs.

The second innovation revolutionized every aspect of manufacturing by applying the light speed of knowledge accumulation and transmission and data processing afforded by computers, from computer-aided design, to computer-aided engineering, to computer-aided manufacturing, taking the manufacturing transformation process full circle. Known as the Third Industrial Revolution, the digitization of manufacturing is already in full force.

Today, the combination of these two innovations has transformed manufacturing. Products are designed digitally, instead of laboriously with pencil and paper, and are engineered using the vast amounts of materials data, and their responses to environmental stimuli are also modeled and simulated before a single production mold is made and before a single production run is committed.

This combination of material knowledge and digitization saves on the cost and process time typically involved in producing several iterations of prototypes, compressing the time to market for manufactured goods.

A prime example of the power of these innovations is the Boeing 777, the first "paperless" aircraft manufactured with a *single* prototype. This would never have been possible without the computing power and materials knowledge developed in the 20th century.

Indeed, the aviation industry has been a significant driver of innovation in both materials and manufacturing, from the need for better understanding of metal fatigue caused by altitude changes during flight, to the need for lighter but yet stronger materials to produce ever larger aircraft that are more fuel-efficient. The Boeing 787 Dreamliner is today's result of that early work, culminating in a vehicle that is 50 percent (by weight) composed of composite materials (compared to

12 percent in the Boeing 777), increasing fuel efficiency, extending distance and reducing costs.

Lean manufacturing and *advanced manufacturing* refer to these advances in materials and process compression, reducing time to market and increasing product design and engineering efficiencies.

Reductions in costs of prototyping and molding also mean that a single run of a million parts is no longer as necessary as it might earlier have been to amortize the initial capital investment in the production mold. Today, these initial costs have fallen so dramatically, and computing power made so widely affordable and available, that manufacturing is becoming a desktop capability. The cycle has gone from mass production to mass customization—a single manufactured product for each individual's needs.

…. and Disruption

Of course, such transformational change does not occur in a vacuum. Among the consequences have been disruptive employment effects.

Simulation and digitization has eliminated the need for many incremental prototypes, but have led to the rise of software engineers, programming the modeling and simulation systems that replace the prototyping and mold development steps, and mechanical and structural engineers, who use these systems to program engineering software.

The third innovation—globalization—has created broadened opportunities, as well as challenges, opening new markets in which to sell products, but also opening up new markets for inputs. Advances in communications allow research and development teams to be assembled anywhere, communicating digitally, where human capital can be optimized, by discipline, need and cost.

Globalization also allows the research, design, engineering and manufacturing to occur independently of each other, no longer constrained by geographic or political boundaries, but where they can be done most efficiently. The competitive characteristics of each geography will dictate where any of the steps in the manufacturing process will take place. The engineering may be done in the cloud, with a design team in Shanghai or San Jose, while the manufacturing may take place in Vietnam or Valencia, depending on the costs and qualities of the inputs needed—such as land, labor and capital—and depending on whether local capability exists to deliver the quality of production needed.

Manufacturing's transformation has also reduced the need for production workers, as automation has reduced the number of workers on production lines from many to a single technician with a computer numerical control device (CNC) monitoring an automated production line that runs continuous shifts, without breaks for coffee, lunch or vacation.

Increased computerization and technology require larger capital investment to purchase the computing power that enables the transition from labor-based processes to digital processes. This substitution of labor with capital has also changed the economics of manufacturing. Where yesterday's factory floor teeming with low-cost labor found efficiencies in low-wage nations, today's manufacturing depends on high quality and quick response to customer demands. In the 21st century, manufacturing is moving beyond the mass production and automation that drove the productivity gains of the mid 20th century. In the 21st century, the nature and processes of how goods are produced is fundamentally changing.

In This Report

How will California fare in this landscape? Will the state's industrious workers and innovative companies leverage their individual and collective strengths and resources amid these industry-wide changes to more fully and nimbly compete on the global manufacturing stage? Will some industries find more hospitable homes elsewhere? If so, why?

In this report, the LAEDC Institute for Applied Economics (IAE) assesses the manufacturing industry in California from an employment and competitiveness perspective.

In Section 2, the manufacturing sector and its value to the national economy are reviewed. This section shows that while manufacturing employment has fallen by 33 percent since 1990, output has increased by almost 50 percent (in nominal terms). This can only have happened because of the rise in labor productivity, particularly in durable goods manufacturing, which is more capital intensive. In fact, each hour of manufacturing labor today produces twice the value of output it did in 1990 (in real terms). Manufacturing labor productivity growth has been higher than all other sectors of the economy. As a result, manufacturing labor has been paid a premium of at least 50 percent over wages in other industries.

Section 2 concludes by showing that while California is a major contributor to U.S. manufacturing (the largest, in fact), and the growth rate of its value added has outstripped that of the nation, California's diverse economy makes it less dependent on the contribution of manufacturing to the state's economy than other states, such as Oregon, Indiana, North Carolina and Wisconsin—all of which are highly dependent on their manufacturing industries for their economic vitality.

Section 3 provides a detailed discussion of manufacturing employment in California at the industry level, and how this has changed since the turn of the century. This ten-year retrospective is chosen rather than a longer-term view because there is consistency in the industry data over this period which allows an apples-to-apples comparison, and because both 2002 and 2012 represent post-recession recovery years.

The employment picture has not been a positive one. While manufacturing industries in California range across the spectrum, from high technology industries such as computer and electronic products, aerospace parts and products and medical devices, to low technology manufacturing such as apparel and food processing, the sector overall has lost almost 40 percent of its employment from 1990 to 2012. Virtually all manufacturing industries lost jobs, and some lost more than half of their employment in the ten years since 2002 alone.

Section 3 closes with a review of the occupations currently employed in manufacturing and the education and experience levels required for entry level positions. It is clear that the sector still provides jobs across skill levels, many of which are well-compensated.

In Section 4, California's manufacturing competitiveness is assessed using two tools that are based on employment data: *employment concentration* and *technological intensity*. Employment concentration is a measure of regional specialization and clustering of activity in a geographic region, and is quantified using location quotients. Technological intensity is a measure of how advanced the manufacturing is in a region, using research and development investment as a yardstick. High technologically intensive industries are those that invest a larger proportion of the value of their production in R&D. These are industries that are more likely to innovate, improve their processes and products, gain market share, be competitive in a global economy and generate wealth for the region. The proportion of manufacturing employment in such industries is an indicator of the region's overall competitiveness.

The findings of this assessment are that California is competitive in both high technology industries, including semiconductors, computers, peripherals electronic components, communications equipment, and the sophisticated radar and satellite instrumentation used in aerospace, and also in low technology industries, such as apparel, beverages, machinery and food processing.

While some competitiveness has declined over the decade across technological intensities, several industries at the high end and at the low end have become stronger. The manufacturing industry clusters that are the basis of this and their recent performance are discussed in more detail in Section 5, and analysis at the county level for Southern California in Section 6 shows that regional specialization is quite significant.

Where to Now?

The findings of this report point to a number of clear conclusions:

- *Manufacturing is changing*

From applecarts to aircraft and from staplers to stents, the process of manufacturing goods is being transformed through an abundance of affordable computing power, an explosion of material sciences and an increasingly accessible global marketplace of ideas and factories. This transformation is changing the demand for labor—both its quantity and its quality—even as the value of production keeps rising.

- *Manufacturing employment will continue to decline*

Increased productivity through process compression, automation and off-shoring shows no sign of abating in the near future. Employment declines in manufacturing will continue as the potential for achieving additional efficiencies in existing businesses appears to be large.

However, the composition of this employment may be changing. Research, design and engineering functions, traditionally included in the manufacturing sector, are increasingly being outsourced to specialty shops that are measured as part of the service economy.

Meanwhile, production employment will be situated where it is most competitive, and for many industries this is still in areas where labor costs can be minimized.

- *Workforce training is still needed*

Because manufacturing processes in both high technology and low technology industries are becoming more dependent on technical tools (both hardware and software), specific training will continue to be needed. The speed of innovation today demands that industry be involved in developing appropriate training programs and in forming partnerships with learning centers and colleges so that candidates are job-ready for available occupations. This may also involve ensuring that instructors themselves are kept abreast of technological progress occurring in industries that their students need to be schooled for.

Not only is such training necessary to prepare job entrants, it is critical to the continual process of creative destruction within industry. As retiring workers take their skills with them, their replacements bring knowledge of and training in newer products and practices to existing manufacturers, accelerating adoption and innovation across industry.

- *Human capital is mobile*

Although manufacturing has become more capital intensive, its competitive edge continues to exist in human capital and entrepreneurship – which can reside anywhere. Globalization and communication networks have made it possible to assemble the most qualified and creative research and design teams from highly-skilled, highly-educated workers living anywhere around the world.

These are the very individuals that drive innovation and competitiveness and that generate wealth within their own communities. Their choice of where to reside will depend on quality of life issues, such as availability of educational resources and research labs to facilitate their discoveries, access to computing power and communication infrastructure, such as ubiquitous wireless capability, to enable seamless collaboration across miles, and a thriving innovation ecosystem that generates ideas, advancements and excitement.

- *Industry diversification remains important*

Finally, diversity of industry mix is a competitive strength, not only within the manufacturing sector but across all sectors of an economy. A region with competitive strength in several industry clusters is less vulnerable to a systematic risk of exposure to the business cycle. While concentrations of activity in specific industries should be nurtured and maintained, a larger goal would be to encourage a spectrum of industry strength, in both high technology and low technology fields, in manufacturing and in services, each competitive in its own market and providing employment for local residents.

Diversification also permits a wider and deeper supply chain, keeping dollars within the economic region and multiplying the overall economic benefits. Even industries lacking competitive strength may be vital as suppliers to another, perhaps stronger, regional industry. Hence a deeper understanding of the needs of regional industries is critically important. ❖

2 Manufacturing's Economic Performance

Having led the world as a manufacturing powerhouse for decades, the United States ceded its number one berth for the first time this year, as globalization enabled the rise of increasingly productive factory floors in the emerging nations of Asia and around the globe.

Still, manufacturing activity plays a vital role in the U.S. economy, generating jobs for millions of workers, providing incomes for households across the economic spectrum, and producing necessary and innovative products for domestic consumption and export.

Manufacturing Output

In 2012 (the most recent year for which complete data is available), the industry accounted for 12.3 percent of U.S. gross domestic product (GDP) and nine percent of total employment. The value of production in the manufacturing sector has nearly doubled in nominal terms since 1990, reaching $3.9 trillion in 2012 (Exhibit 2-1). While production value in both durable and nondurable manufacturing increased over the period, the increase in nondurable manufacturing was responsible for 66 percent of the total increase.

Output levels in the manufacturing sector have been increasing, though they did experience declines during recessionary periods, notably the early 1990s, the dot com bubble in early 2000s and more recently the Great Recession (Exhibit 2-2). Manufacturing output in 2012 had grown by 46.7 percent over 1990, an average annual growth rate of 1.75 percent. Split between durable and non-durable manufacturing, performance in durable manufacturing exceeded that of nondurables, the output level in 2012 increased over that of 1990 by 78.5 percent and 13.7 percent respectively.

Compared to other sectors of the economy, however, manufacturing output growth has not fared as well since the turn of the century (Exhibit 2-3). As of 2012, output in the manufacturing sector has grown by 46.7 percent over its 1990 level, while aggregate output growth in the private sector has grown by 84.9 percent over the period, an average annual growth rate of 2.8 percent. Since this *includes* the manufacturing sector, it is clear that the service economy has seen significant growth.

Exhibit 2-1
U.S. Manufacturing Value of Production
Billions of current dollars

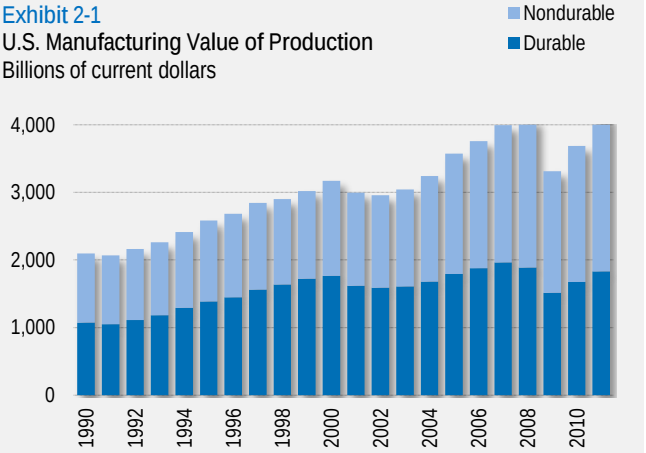


Exhibit 2-2
U.S. Manufacturing Output
Indexed Growth (1990 = 100)

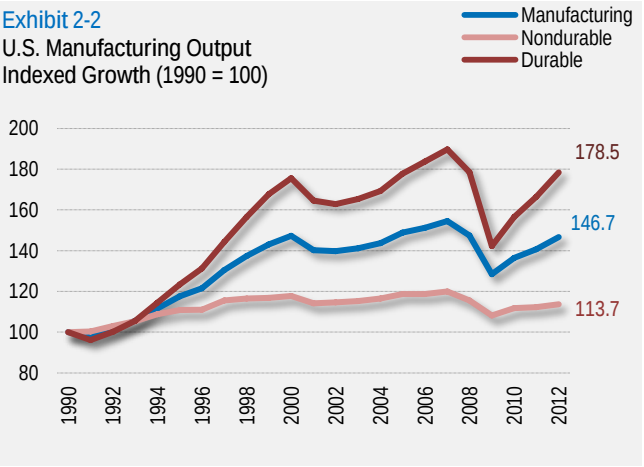


Exhibit 2-3
U.S. Manufacturing Output
Indexed Growth (1990 = 100)

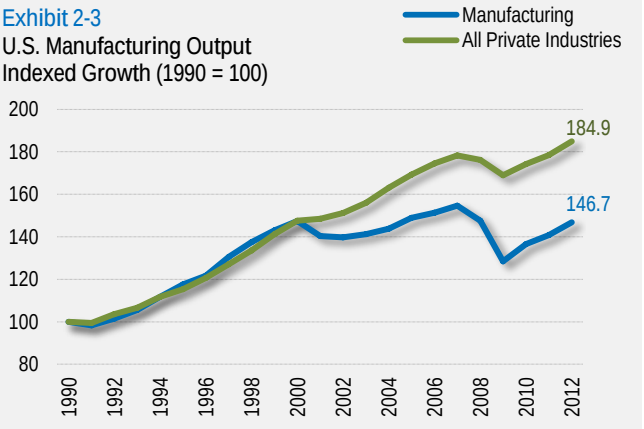


Exhibit 2-4
U.S. Manufacturing's Contribution to GDP

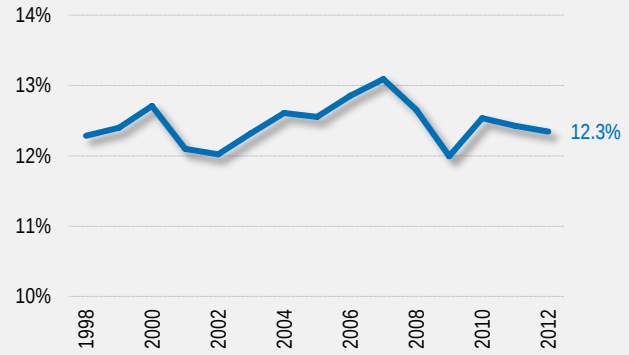


Exhibit 2-5
U.S. Manufacturing Employment
(in millions)

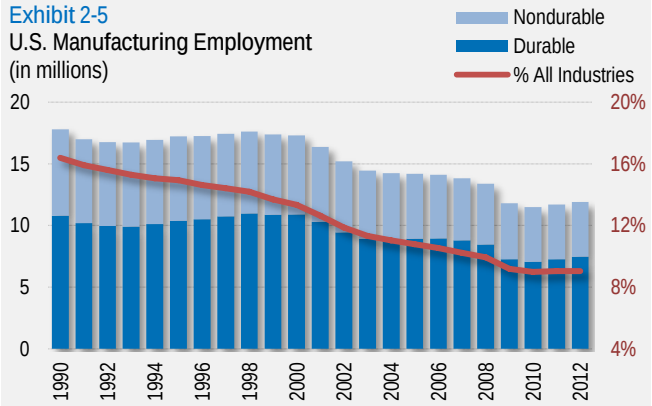
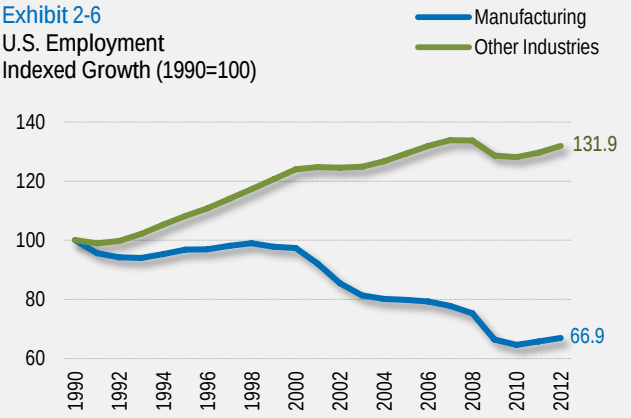


Exhibit 2-6
U.S. Employment
Indexed Growth (1990=100)



Still, despite the rise of output in the services sectors, manufacturing's contribution to GDP has held relatively stable, accounting for between 12 and 13 percent of total national gross domestic product (Exhibit 2-4).

Manufacturing Employment

The manufacturing sector has been, and still is, a large share of total employment; however, employment levels over time have been steadily declining (Exhibit 2-5). Almost 6 million manufacturing jobs were lost between 1990 and 2012, paring the sector by a full third, and the industry share of total employment fell from 16.4 percent in 1990 to 9.0 percent in 2012. The decline has occurred in both durable manufacturing industries and nondurable manufacturing, although the forces driving the decline in the two segments of the industry may be quite different.

While manufacturing has been hemorrhaging employment, other sectors have been adding jobs (Exhibit 2-6). Between 1990 and 2012, almost 29 million jobs were added in nonmanufacturing industries, increasing employment by almost 32 percent, compared to the 33 percent loss of manufacturing jobs.

Productivity of Labor and Capital

While manufacturing employment continues to fall, it also continues to generate increases in the value of manufacturing production and its consistent contribution to GDP. It is clear that American labor productivity has been increasing. Higher productivity per worker can be achieved through improved skill levels of those employed, or through capital investment, so that each worker is able to produce more (with better equipment) in spite of not being more highly skilled—or a combination of both.

In manufacturing industries, the exponential growth of computing power, the digitization of manufacturing, automation of manufacturing processes and advances in materials which have revolutionized the products being manufactured, have all boosted labor productivity in the United States.

Over time, this has resulted in a shift of the industry domestically. Manufacturing operations that require relatively low-skilled workers, such as those found in many nondurable manufacturing industries, were the first to be susceptible to automation and off-shoring.

As these jobs have been lost, employment in more technology-intensive manufacturing operations will account for a larger share of manufacturing employment in spite of an overall decline in employment. Workers that remain in these industries are those with higher skill levels and are consequently those earning higher average annual wages.

Labor productivity is a measure of real output per unit of labor input. In manufacturing, labor productivity has been steadily increasing since 1990 (Exhibit 2-7) such that by 2011 each hour of manufacturing labor produces more than twice the value of output it did in 1990 (in real terms).

Gains in labor productivity over the period were even more robust in durable goods manufacturing, where labor productivity increased by 142 percent, an average annual growth rate of 4.1 percent, but even nondurable goods manufacturing boosted labor productivity by 69 percent over the period (an annual average growth rate of 2.4 percent).

Manufacturing productivity growth has been meteoric compared to other sectors (Exhibit 2-8). Productivity growth in the transportation and warehousing sector and services were 35 percent and 22 percent, respectively, since 1990, while productivity in the construction sector actually declined.

The combination of increased use of automation and the emergence of more high-tech manufacturing has increased the share of capital in manufacturing (Exhibit 2-9). In 1990, labor accounted for a third of value added, but this has fallen to 24 percent, while returns to capital have increased from 16.6 percent to 20.5 percent in 2012.

There is no doubt that increasing the capital intensity of manufacturing has boosted labor productivity, but that is only one piece of the productivity picture. A more comprehensive measure is multi-factor productivity (MFP), which measures real output per *combined* set of inputs, including labor, capital and purchased intermediate inputs. Changes in MFP are not attributable to changes in individual inputs, but to the joint effects of inputs working together and hence to the efficient management of the factors of production, to cost advantages (such as, say, in reaching economies of scale), to managerial competency, and to innovation and the incorporation of new products and processes made possible through research and development.

Exhibit 2-7
U.S. Manufacturing Labor Productivity
Output per Hour (1990 = 100)

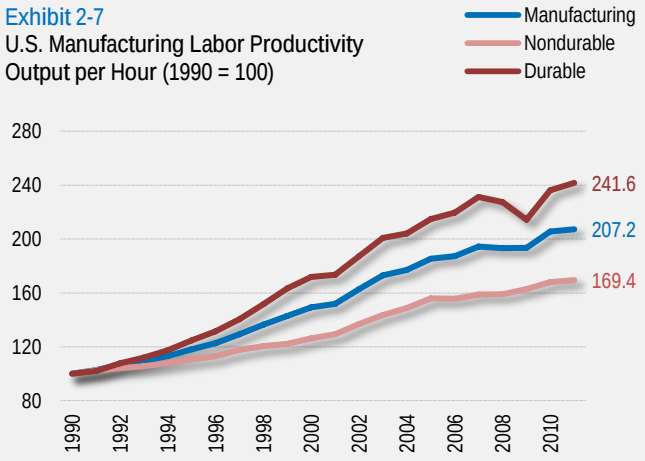


Exhibit 2-8
U.S. Labor Productivity
Output per Hour (1990 = 100)

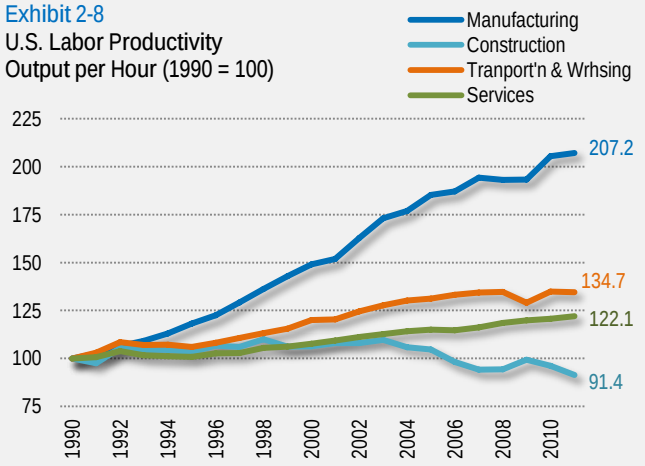


Exhibit 2-9
U.S. Manufacturing Factor Shares

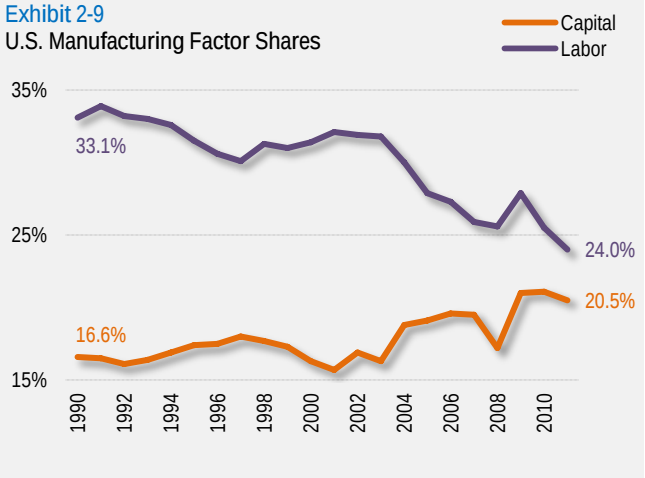


Exhibit 2-10
U.S. Multifactor Productivity Index
(1990 = 100)

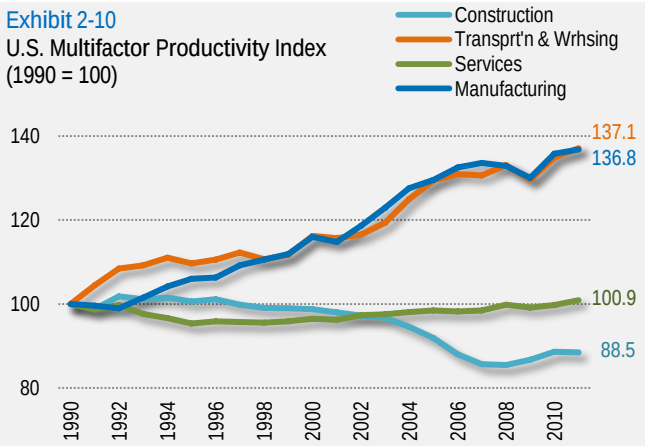


Exhibit 2-11
Composition of Gross Output
U.S. Manufacturing 2012

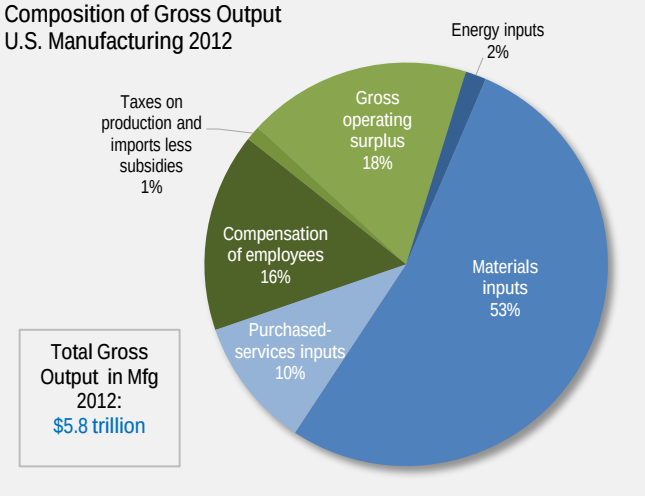
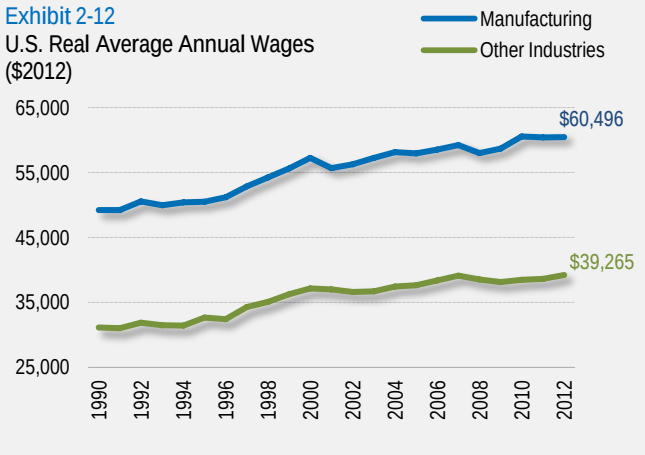


Exhibit 2-12
U.S. Real Average Annual Wages
($2012)



This index has also shown robust growth since 1990 (Exhibit 2-10). Growth in MFP was 36.8 percent from 1990 to 2011. Similar to manufacturing, transportation and warehousing has become more technology intensive and automated over the years, resulting in 37 percent growth in MFP, while there was no growth in multi-factor productivity in services (which includes educations, health care, professional and business services, and leisure and hospitality), and a decline of almost 12 percent in construction.

The overall value of total gross output in the manufacturing sector totaled $5.8 trillion in 2012. Gross output is a combination of value added (GDP) and the cost of intermediate inputs consumed in the production of goods in the sector (Exhibit 2-11). Value added includes operating surplus (which is profit, or the returns to capital), compensation of employees (labor income) and taxes on production.

Interpreting the shares of gross output shows how total expenditures are allocated among the needs of production. Intermediate inputs (energy, materials and purchased services) accounted 65 percent of total expenditures in manufacturing in 2012, with materials accounting for 53 percent of the total. Total value added was 35 percent of the total gross output in the sector.

The allocation of expenditures among these categories provides a visible reminder of the relative importance of each component, and the sensitivity that manufacturing industries in aggregate may have to increased costs in one or several of these components.

Manufacturing Wages

Manufacturing has long been valued as a sector that provides even lower-skilled workers employment opportunities with higher than average annual wages and career ladders through on-the-job training that can lift wages over their working lives.

Indeed, manufacturing wages are higher than wages in other industries (Exhibit 2-12). Real average annual wages across the manufacturing sector have consistently been between 50 percent and 60 percent higher than real average annual wages in all other industries.

Interestingly, though, the increase in real average annual wages since 1990 was 23.9 percent, compared to the increase in labor productivity of 107.2 percent (see Exhibit 2-7)—and compared to the increase in real wages in all other industries of 25.9 percent.

California in Context

Manufacturing activity occurs in every state of the nation, but with more than 11 percent of all jobs in the nation, California's manufacturing sector is also a major contributor to the national industry. The state is the largest state contributor to national manufacturing GDP, representing 11.4 percent, followed closely by Texas with 10 percent (Exhibit 2-13). Far behind are the contributions made by Illinois, North Carolina, Ohio, Indiana and Michigan.

Manufacturing's value added in California has grown twice as fast as the national rate, increasing by almost 73 percent since 1998 compared to less than 32 percent growth for the nation (Exhibit 2-14). However, California's manufacturing sector tumbled during the Great Recession and through the post-recession period even as other regions were recovering. It was not until 2011 that manufacturing value added in California began its recovery, far later than the national pivot in 2009.

It is not surprising, therefore, to see that the contribution made by manufacturing to state GDP has declined since the recession (Exhibit 2-15). Where growth in manufacturing's contribution had been a long, consistent climb prior to the recession, reaching 12.1 percent in 2008, other sectors of the state economy have clearly weathered the recovery better and are now making a larger contribution to state GDP than in the past.

Exhibit 2-13
Contribution to National Manufacturing GDP (2012)

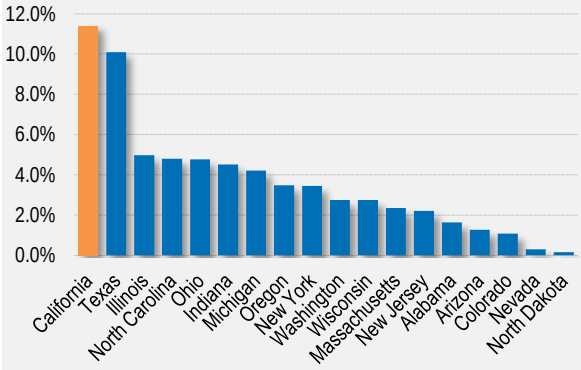


Exhibit 2-14
Growth in Real Manufacturing GDP (1998 to 2012)

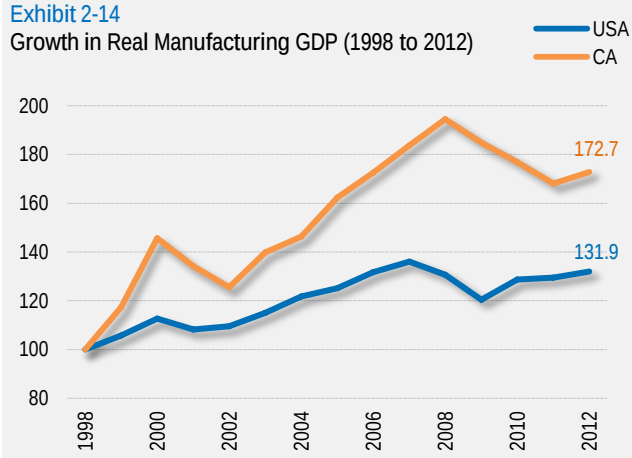


Exhibit 2-15
Manufacturing's Contribution to GDP (1998 to 2012)

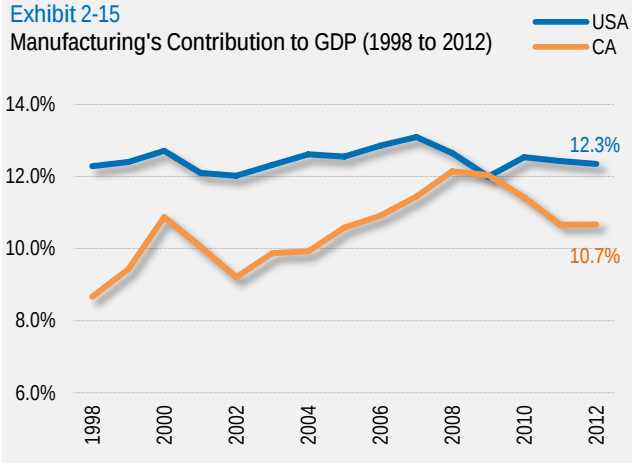


Exhibit 2-16
Manufacturing GDP as Share of State GDP (2012)

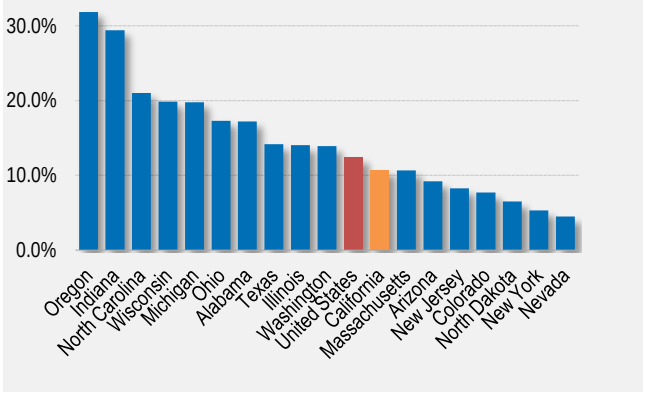


Exhibit 2-17
CA Manufacturing Employment
(in millions)

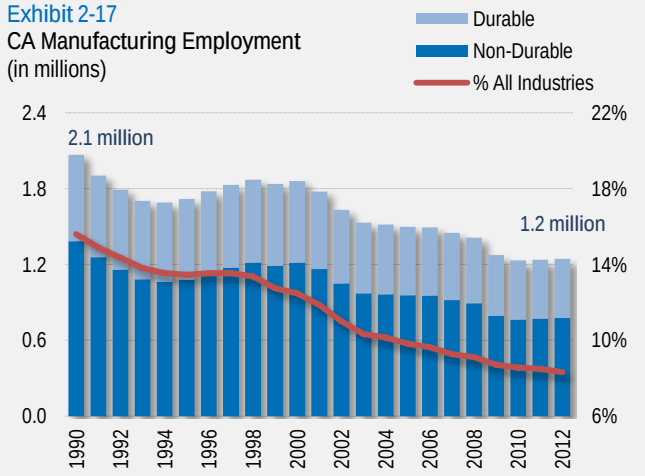
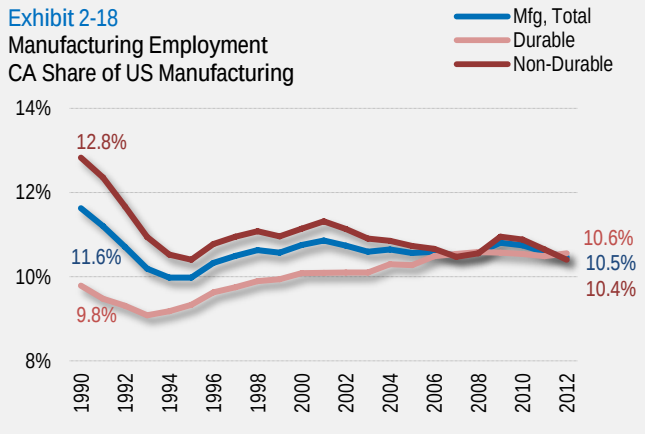


Exhibit 2-18
Manufacturing Employment
CA Share of US Manufacturing



Indeed, manufacturing accounts for a smaller share of overall GDP in California than in many other states (Exhibit 2-16). Given the state's diverse economic base, manufacturing's 10.7 percent share of state product is far less than its 31.9 percent share in Oregon, 29.4 percent share in Indiana, 21.0 percent in North Carolina, and less than manufacturing's share in Wisconsin, Michigan, Ohio, Illinois and Texas, among others. The economic vitality and diversity of the state means that, while important, California does not depend solely on the contribution of its manufacturing sector.

Mirroring the national experience, the decline in manufacturing employment in California has been dramatic, losing 842,180 jobs between 1990 and 2012, or a decline of *almost 40 percent* of all manufacturing jobs (Exhibit 2-17). The loss of durable manufacturing jobs in the early nineties were largely the result of reductions in national defense spending, which disproportionately impacted California's historic aerospace and defense industries—a source of employment and middle class incomes as far back as the second World War. However, the largest declines were in nondurable goods, as California's relatively high labor costs and its proximity to Asian factory floors tip the balance in favor of off-shoring and automation.

Declines since the turn of the century may be more related to the transformational shifts of increased automation, process compression and off-shoring, changes that are occurring in the industry itself rather than to a loss of demand for manufactured products.

As manufacturing employment has declined faster in California than at the national level, California's share of U.S. manufacturing employment has also fallen, from an overall share of 11.6 percent in 1990 to 10.5 percent in 2012 (Exhibit 2-18), but this is almost entirely due to the disproportionate loss of durable manufacturing jobs compared to the nation.

The decline in manufacturing employment has been more than compensated by growth in employment in other industries (Exhibit 2-19). While manufacturing declined by almost 40 percent, all other industries (including government) grew by 22.5 percent.

To understand how a precipitous decline in manufacturing employment can be overcome by a smaller increase in other industries, it is helpful to remember the distribution of employment by industry sector in California (Exhibit 2-20). In 2012, goods-producing industries (natural resources, mining, construction and manufacturing) accounted for 15.2 percent of all employment, while services accounted for almost 70 percent (government employment made up the remaining 15 percent).

These shares have changed somewhat since 2002, when they were 19 percent, 65 percent and 16 percent, respectively. With such a large share of employment in services and government sectors, the loss of manufacturing jobs, while worrisome for a variety of reasons (such as, for example, income levels, income distribution, industry diversification and competitiveness) has been compensated by employment gains in other sectors. ❖

Exhibit 2-19
CA Manufacturing Employment
Indexed Growth (1990=100)

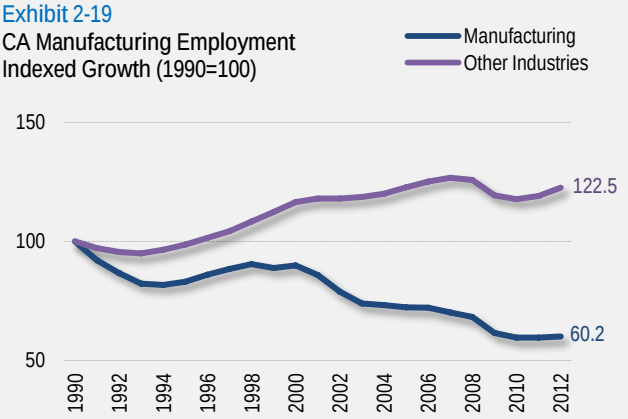
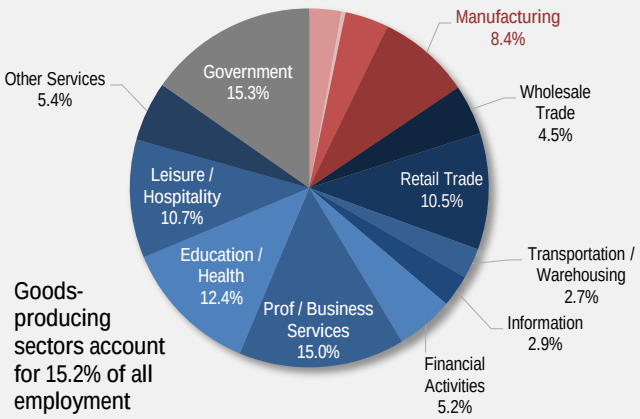


Exhibit 2-20
CA Employment by Industry Sectors 2012



3 Manufacturing Employment in California

Employment in manufacturing is a measure of the number of *jobs* provided by businesses in the industry. Industry employment can be estimated at different levels of industry classifications and can be used to determine the industry composition and identify large employing industries, track relative competitiveness and observe employment trends for the varying types of manufacturing.

Current Industry Composition

The first level of detail in manufacturing is the three-digit industry subsector. There are twenty-one manufacturing subsectors, with ten non-durable and eleven durable goods manufacturing subsectors.

A mix of high-tech and low-tech industries, the three largest employing industry subsectors, computers and electronic product manufacturing, food manufacturing and fabricated metal product manufacturing, accounted for 43.5 percent of the California's total manufacturing employment in 2012 (Exhibit 3-1).

While overall, the manufacturing sector boasts average annual wages higher than average annual wages across all industries, within the sector there are wide disparities among the different subsectors (Exhibit 3-2). The industry subsector with the highest average annual wage (petroleum and coal products manufacturing) is five times that of the subsector with the lowest (textile mills).

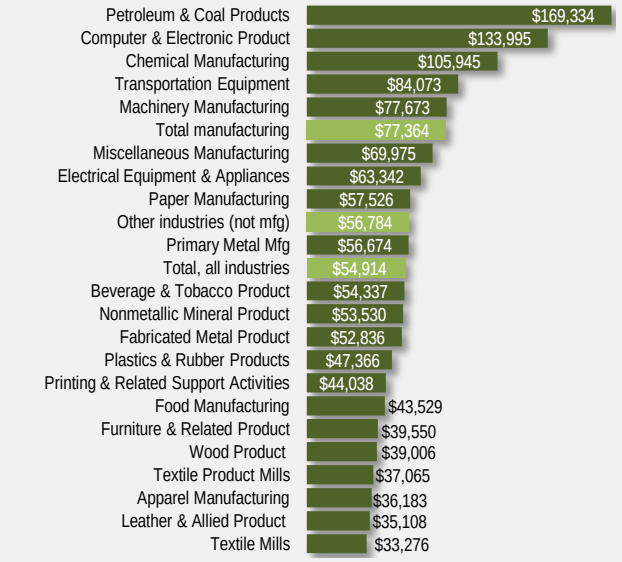
Largest Manufacturing Industries in California Today

Employment data at the industry level provides a more detailed examination of manufacturing sector performance in the state. Larger industry subsectors are segmented into their component industries. For example, the primary metal manufacturing subsector includes: iron and steel mills and ferroalloy manufacturing; steel product manufacturing from purchased steel; alumina and aluminum production and processing, nonferrous metal (except aluminum) production and processing; and foundries.

Exhibit 3-1
Manufacturing Employment by Industry Subsector
California 2012

NAICS	Industry subsector	Jobs	Share of Mfg
334	Computer & Electronic Product Mfg	270,276	21.6%
311	Food Manufacturing	149,114	12.0%
332	Fabricated Metal Product Mfg	123,426	9.9%
336	Transportation Equipment Mfg	101,931	8.2%
339	Miscellaneous Manufacturing	82,847	6.7%
325	Chemical Manufacturing	75,812	6.1%
333	Machinery Manufacturing	70,763	5.8%
315	Apparel Manufacturing	56,573	4.5%
312	Beverage & Tobacco Product Mfg	44,484	3.6%
326	Plastics & Rubber Products Mfg	44,303	3.6%
323	Printing & Related Support Activities	42,129	3.4%
337	Furniture & Related Product Mfg	31,523	2.5%
335	Electrical Equipment & Appliances	29,013	2.3%
327	Nonmetallic Mineral Product Mfg	28,171	2.3%
322	Paper Manufacturing	21,314	1.7%
331	Primary Metal Manufacturing	19,778	1.6%
321	Wood Product Manufacturing	19,365	1.6%
324	Petroleum & Coal Products Mfg	14,651	1.2%
313	Textile Mills	8,693	0.7%
314	Textile Product Mills	8,317	0.7%
316	Leather & Allied Product Mfg	3,468	0.3%
Total Manufacturing		1,245,774	100.0%
	Percent of State Employment	*8.3%*	

Exhibit 3-2
Average Annual Wages in Manufacturing
California 2012



The 25 largest employing manufacturing industries in California in 2012 represented 24.4 percent of all manufacturing employment in the state, and 1.6 percent of all employment across all industries (Exhibit 3-3).

The largest industry group in terms of employment in California is semiconductor and other electronic components manufacturing, which is concentrated in Northern California. With almost 90,000 jobs, this industry accounted for more than 7 percent of all manufacturing jobs in 2012. The second largest industry group was the manufacturing of navigational, measuring, electromedical and control instruments, an industry concentrated in Southern California that supplies highly technical satellite and radar systems to the aerospace industry. This industry, along with the third-largest industry of aerospace products and parts manufacturing, accounted for more than 12 percent of all manufacturing jobs in the state in 2012.

Change in Manufacturing Employment in California

How have these industries fared since 2002? This ten-year period (which began and ended in the 21st century) spans an entire business cycle, with both 2002 and 2012 representing post-recession recovery years.

Although overall the manufacturing sector lost jobs from 2002 to 2012, it is possible that individual industries grew while others shrank. If so, understanding why there were winners and losers, and which industries were successful, would help inform initiatives designed to promote manufacturing in California.

Of the twenty-one manufacturing subsectors, only one subsector (beverage and tobacco product manufacturing) gained jobs between 2002 and 2012 (Exhibit 3-4). This subsector is small, with less than 35,000 jobs in 2002, and this growth was an increase in employment of 30 percent over ten years. The largest number of jobs lost was in computer and electronic product manufacturing; this subsector shed 92,040 employees over the period.

Exhibit 3-3
Largest Manufacturing Industries by Employment
California 2012

NAICS	Description	Jobs	Share of Mfg
3344	Semiconductor / other electr components	88,818	7.1%
3345	Navigational / measuring / electromedical / control instruments mfg	81,603	6.6%
3364	Aerospace product and parts mfg	70,482	5.7%
3341	Computer and peripheral equipment mfg	60,833	4.9%
3391	Medical equipment and supplies mfg	53,331	4.3%
3152	Cut and sew apparel mfg	53,182	4.3%
3121	Beverage mfg	44,446	3.6%
3254	Pharmaceutical and medicine mfg	44,229	3.6%
3231	Printing and related support activities	42,129	3.4%
3327	Machine shops; screw, nut and bolt mfg	41,736	3.4%
3118	Bakeries and tortilla mfg	40,133	3.2%
3261	Plastics product mfg	38,557	3.1%
3114	Fruit / vegetable preserving / specialty food	30,636	2.5%
3399	Other miscellaneous mfg	29,516	2.4%
3323	Architectural and structural metals mfg	27,387	2.2%
3342	Communications equipment mfg	27,090	2.2%
3119	Other food mfg	25,183	2.0%
3116	Animal slaughtering and processing	20,957	1.7%
3222	HH / institutional furniture / kitchen cabinets	20,325	1.6%
3371	Converted paper product mfg	20,199	1.6%
3115	Dairy product mfg	17,243	1.4%
3329	Other fabricated metal product mfg	17,232	1.4%
3339	Other general purpose machinery mfg	16,679	1.3%
3328	Coating / engraving / heat treating / allied	15,298	1.2%
3241	Petroleum and coal products mfg	14,651	1.2%
	All other manufacturing industries	*303,899*	*24.4%*
	Total Manufacturing	1,245,774	100.0%

Exhibit 3-4
Manufacturing Employment by Subsector
Numerical Change from 2002 to 2012

Total Δ in Mfg Employment 2002 -12: -387,020

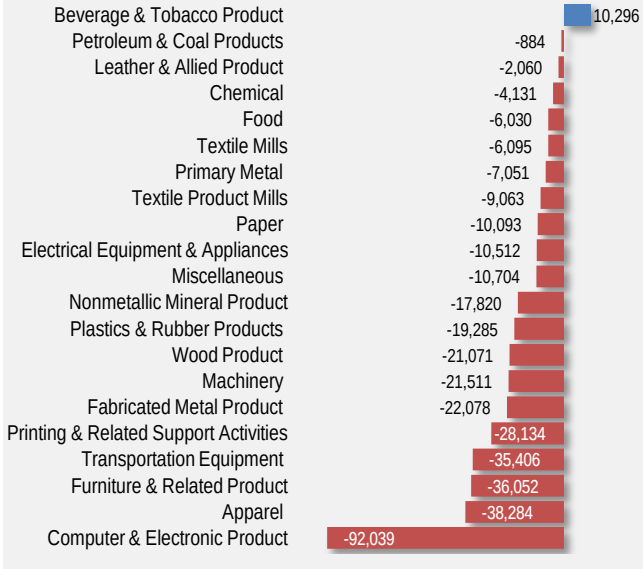
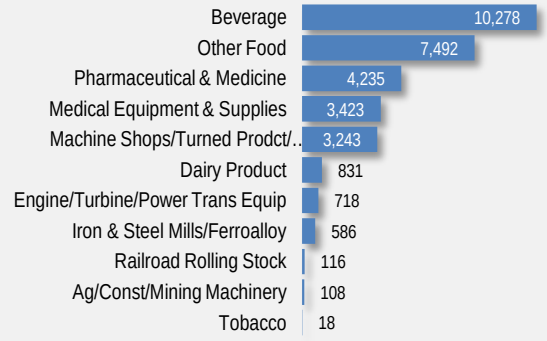
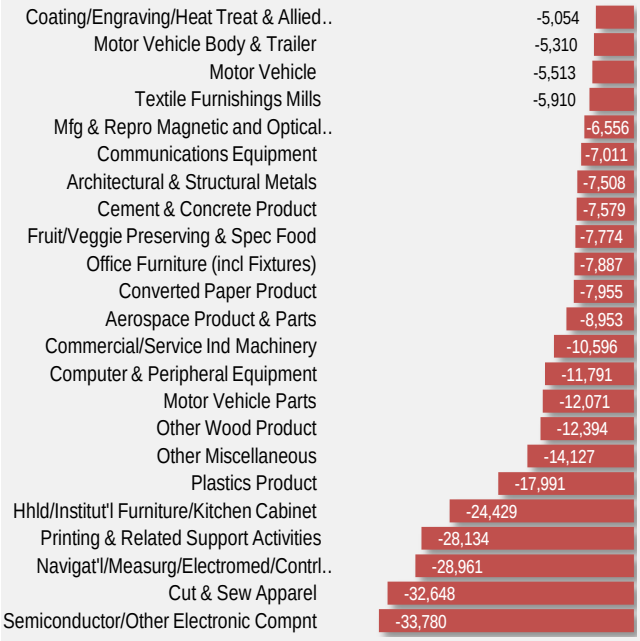


Exhibit 3-5
Mfg Industries with Employment Increases
Numerical Change from 2002 to 2012



More detailed industry defintions show that some industry groups were able to grow in spite of overall manufacutring employment declines.

Exhibit 3-6
Industries with the Largest Employment Losses
Numerical Change from 2002 to 2012



Still, each subsector is an aggregate of more detailed industries. At the industry level, there were several that added jobs (Exhibit 3-5). Again, beverage manufacturing is at the top of the list, have added 10,278 jobs since 2002, along with other food manufacturing, which added 7,492 jobs.

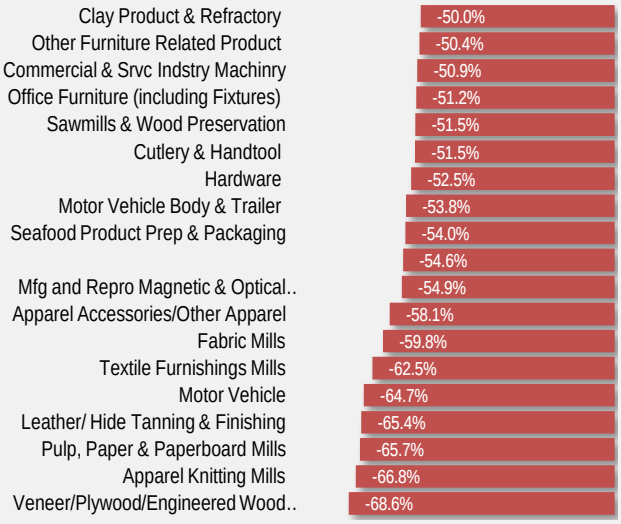
The remaining industries showing job gains are components of subsectors that experienced overall job losses. For example, pharmaceutical and medicine manufacturing added 4,235 jobs over the period, an increase in employment of 11 percent since 2002. This industry is a part of the chemical manufacturing subsector along with six other component industries, each of which lost jobs over the period.

Employment losses were widespread across many industry groups, many of which lost substantial shares of their employment (Exhibit 3-6).

Indeed, at least eighteen industry groups have lost *more than half* of their employment since 2002 (Exhibit 3-7). For the most part, these were industries related to apparel and other clothing manufacturing and wood and furniture manufacturing.

For complete employment and wage data by industry subsector and industry group, see Exhibits A-1 and A-2 in the Appendix.

Exhibit 3-7
Industries That Lost at Least Half Their Employment
Percentage Change from 2002 to 2012



The Manufacturing Workforce

There are many diverse occupations in the manufacturing sector, with jobs in accounting, sales, office and administrative services, on the production line and in engineering and computer sciences (Exhibit 3-8). More than 43 percent of all manufacturing jobs are in production occupations. These include such roles as machinists, welders and cutters, team assemblers, machine operators, inspectors, testers, production helpers, and many others. At the national level, more than 51 percent of all manufacturing workers are in production occupations, suggesting a higher degree of automation in California than in the rest of the nation.

Office and administrative occupations account for more than 10 percent of all manufacturing jobs, and architectural and engineering occupations (mostly engineering) are almost 9 percent of all jobs. At the national level, the share of workers in architectural and engineering occupations is less than 7 percent, and computer and mathematical occupations are 2.3 percent, supporting the notion that manufacturing is more technologically intensive than other areas.

The median annual wages vary widely across these occupational groups, with a difference of more than $100,000 between the highest earning occupational group (management) and the lowest earning occupational group (transportation and material moving) (Exhibit 3-9).

Given the wide range of occupations, it is expected that a diversity of knowledge, skills and abilities would be needed. In fact, more than half of all jobs in manufacturing require a high school diploma (or equivalency) only for an entry level job, and 14 percent of jobs are open to candidates without a high school diploma (Exhibit 3-10). Another 21.6 percent requires a bachelor's degree.

Work experience required for an entry level position is often used as an acceptable substitute for formal education or training. In manufacturing, more than 81 percent of jobs require *no work experience* for an entry level position. This would imply that many job entrants gain on the job training and work experience to gain whatever competency is needed in their roles.

This lends credence to the assertion that manufacturing provides employment for workers at all skill levels and with levels of education—including those without a high school diploma and those with post-graduate degrees.

Exhibit 3-8
Occupational Distribution CA Manufacturing Sector
By Major Occupation Group

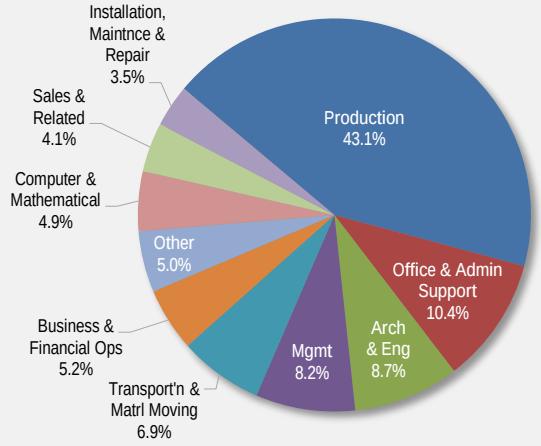


Exhibit 3-9
Median Wages in the CA Manufacturing Sector
By Major Occupation Group

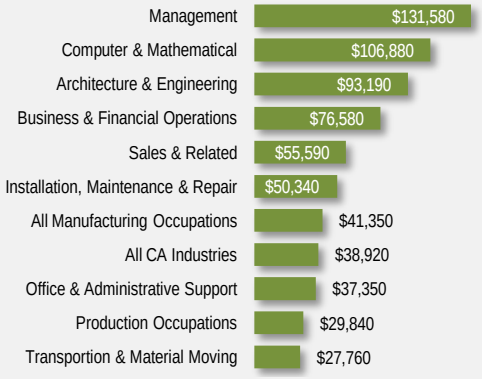


Exhibit 3-10
Entry Level Education Required

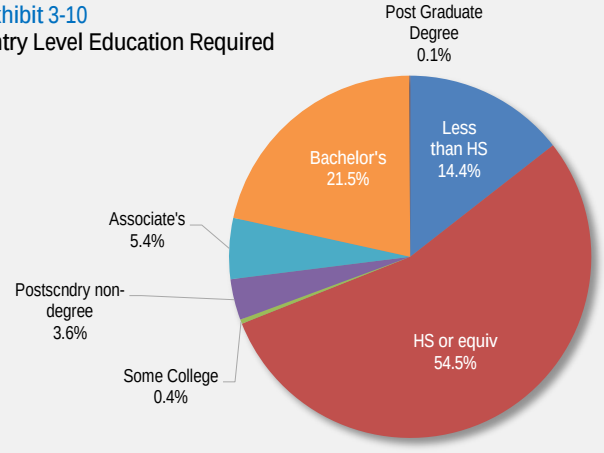


Exhibit 3-11
Entry Level Education Required
For Production Occupations

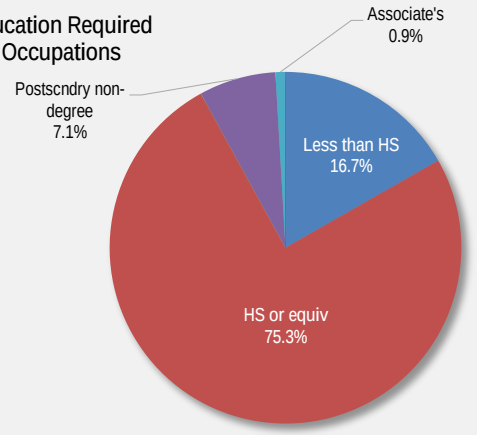


Exhibit 3-12
Median Wages in the CA Manufacturing Sector
For Production Occupations

Production Workers

Workers directly involved in the production of goods, such as machinists, welders, assembly workers, first-line supervisors, layout specialists and machine setters, operators and tenders, are categorized in the major occupational group of production occupations. It is commonly thought that these types of occupations are more accessible to lower skilled workers, and that many such occupations pay relatively high wages. These details may not be particularly evident in the data presented above relating to major occupational groups.

Despite the move towards higher technology processes and tools in manufacturing industries, production occupations still provide opportunities for those with lower levels of educational attainment. Almost 17 of entry level production jobs are open to candidates with less than a high school education, and more than 75 percent are open to candidates with a high school diploma (or equivalent) (Exhibit 3-11).

However, these typically are the occupations with the lowest median wages (Exhibit 3-12). Production occupations overall earned $29,840, less than 75 percent of the manufacturing median. Only first-line supervisors earned higher median wages.

Interestingly, the mix of occupations in manufacturing industries has not materially changed since 2002. Although it is known that automation has replaced the need for some production workers, and the adoption of lean and advanced manufacturing techniques would be expected to increase the need for engineers and other highly-educated workers, these shifts are not evident in the data. It is possible that design and engineering work that was once done in house has been increasingly outsourced to specialty firms. If so, there would be a redistribution of occupations among different industry sectors. This is not examined here but is an issue worthy of further research. ❖

4 California's Competitiveness in Manufacturing

Understanding and parsing the details of employment in California's manufacturing industries and recent trends provides a rather clear picture of current conditions and a look-back to the recent past. What this does not do well is provide insight into the direction that these industries are going, how are they doing in comparison to other regions, judging their potential success, or uncovering the pitfalls they may encounter going forward. Competitiveness is a function of many factors, including relative costs of inputs such as labor and energy and the productive capability of individual companies. While in-depth industry analysis may be needed to uncover all factors influencing industries, there are two tools that may be helpful in assessing competitiveness using employment data. These are *employment concentration* and *technological intensity.*

Employment Concentration as a Measure of Competitiveness

Employment concentration provides a simple measure to compare the importance of an industry in a region compared to a larger region. This is encapsulated in a ratio called a *location quotient,* which is the ratio of the percentage of total employment in an industry in the region of interest compared to that same percentage nationally. For example, if 6.8 percent of employment in California is in apparel manufacturing, while across the nation only 2 percent is employed in fashion, then the location quotient for fashion in California is 3.4. A location quotient of 1 would indicate that the local industry concentration is identical to that of the nation.

A higher employment concentration is an indication that the industry is relatively more concentrated regionally than the national average. This is evidence of clustering of activity. One interpretation of such concentration is that existing conditions in the region are conducive to the success of that industry. Competitive advantage can be the result of well-developed supplier networks, a supply of skilled labor, proximity to transportation networks, adequate infrastructure or access to natural resources.

Of twenty-one manufacturing industry subsectors, six manufacturing subsectors in California demonstrate a competitive edge in terms of relative employment concentration (Exhibit 4-1). These are, in order: apparel manufacturing; computer and electronic products manufacturing; beverage and tobacco product manufacturing; miscellaneous manufacturing (which includes medical devices, sporting goods and musical instruments); petroleum and coal products manufacturing (which includes refining); and leather and allied products.

At the bottom of the list are primary metal manufacturing, paper manufacturing, wood product manufacturing and machinery manufacturing. These are industry subsectors that are less concentrated in terms of employment than in the nation.

Given the size of the state economy, a lack of competitiveness does not mean that these industries are not large sources of employment. However, even if industry employment in the state is significant in terms of employment levels, a location quotient of less than 1 means that the industry is not as important to the regional economy as it may be in other regions.

Exhibit 4-1
Competitiveness of Manufacturing Industry Subsectors
California 2012

NAICS	Industry	LQ
315	Apparel Manufacturing	3.4
334	Computer and Electronic Product Mfg	2.2
312	Beverage & Tobacco Product Manufacturing	2.1
339	Miscellaneous Manufacturing	1.3
324	Petroleum & Coal Products Manufacturing	1.2
316	Leather and Allied Product Manufacturing	1.1
311	Food Manufacturing	0.9
325	Chemical Manufacturing	0.9
323	Printing and Related Support Activities	0.8
337	Furniture and Related Product Mfg	0.8
332	Fabricated Metal Product Manufacturing	0.8
335	Electrical Equipment and Appliances	0.7
327	Nonmetallic Mineral Product Mfg	0.7
313	Textile Mills	0.7
314	Textile Product Mills	0.6
336	Transportation Equipment Manufacturing	0.6
326	Plastics & Rubber Products Manufacturing	0.6
333	Machinery Manufacturing	0.6
321	Wood Product Manufacturing	0.5
322	Paper Manufacturing	0.5
331	Primary Metal Manufacturing	0.4
	Total Manufacturing	0.9

Exhibit 4-2
Competitive Manufacturing Industries
California 2012

NAICS	Industry	LQ
3152	Cut and sew apparel mfg	3.8
3341	Computer and peripheral equipment mfg	3.2
3343	Audio and video equipment mfg	2.8
3346	Manufacturing / reproducing magnetic and optical media	2.3
3121	Beverage mfg	2.2
3342	Communications equipment mfg	2.1
3344	Semiconductor and other electronic component mfg	2.0
3345	Navigational / measuring / electromedical / control instruments mfg	1.8
3169	Other leather and allied product mfg	1.7
3133	Textile and fabric finishing and fabric coating mills	1.6
3114	Fruit and vegetable preserving / specialty food mfg	1.6
3391	Medical equipment and supplies mfg	1.5
3254	Pharmaceutical and medicine mfg	1.4
3159	Apparel accessories and other apparel mfg	1.3
3351	Electric lighting equipment mfg	1.3
3119	Other food mfg	1.3
3364	Aerospace product and parts mfg	1.2
3118	Bakeries and tortilla mfg	1.2
3332	Industrial machinery mfg	1.2
3241	Petroleum and coal products mfg	1.2
3115	Dairy product mfg	1.1
3333	Commercial / service industry machinery mfg	1.1

Exhibit 4-3
Competitive Mfg Industries That Grew Stronger

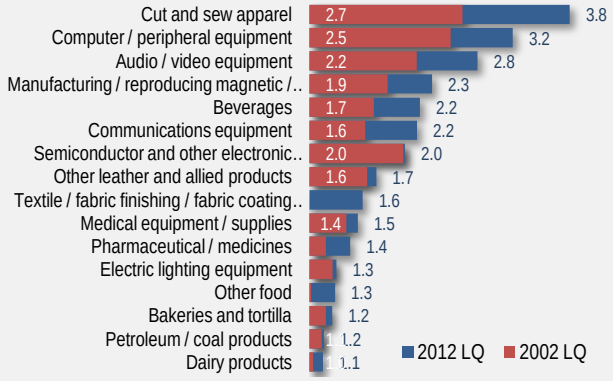
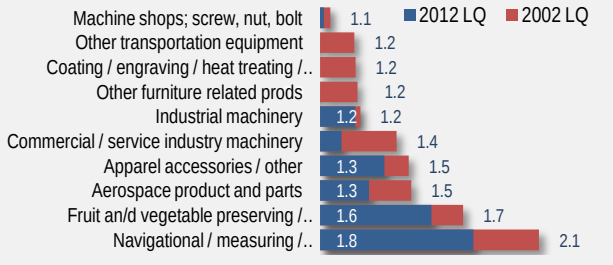


Exhibit 4-4
Competitive Mfg Industries That Lost Strength



Still, industry subsectors are aggregations of industries, and it is possible that the state may have competitive strength in specific industries that are component parts. There are twenty-two competitive manufacturing industries in California (Exhibit 4-2). This includes a diverse set of industries related to fashion and apparel, high tech industries involved in computers and semiconductors, aerospace parts and instrumentation, medical and pharmaceutical manufacturing, and food and beverage manufacturing.

Performance of Competitive Industries

Industries can become more or less concentrated over time. Increased relative concentration occurs when employment in the industry grows in the region faster than it does in the nation, while decreased relative concentration occurs when employment in the industry is growing faster elsewhere than it is regionally. This can also mean that other industries in the region are growing faster at the industry's expense. These changes are measured in changes in location quotients over time.

California has seen some competitive industries become stronger since 2002 in terms of relative employment concentration. These include industries in apparel manufacturing, high tech manufacturing, biomedical industries, and food and beverage manufacturing (Exhibit 4-3).

The state has also seen some of its competitive industries losing strength since 2002. Of the 23 industry groups exhibiting a regional specialization with a location quotient of at least 1.1 in 2002, ten have lost competitive strength (Exhibit 4-4).

Size, Competitiveness and Performance

Because location quotients are calculated using relative employment shares of two separate geographies (such as the state of California and the U.S. here), changes in location quotient can be the result of employment changes in either geography.

Thus, changes in the state's location quotient accompanied by little or no change in employment indicate a change in the industry's employment at the national level. Conversely, changes in state employment accompanied by little to no change in the location quotient indicate a concurrent change in industry

concentration nationwide. The policy implications for such changes may be quite different.

There are four combinations of changes in location quotient and employment: (i) those increasing in competitiveness and getting larger in terms of employment; (ii) those increasing in competitiveness but getting smaller; (iii) those losing competitiveness and getting larger; and (iv) those losing competiveness and getting smaller (Exhibit 4-5).

Simultaneous growth in employment and industry concentration is intuitive. Businesses in such industries have chosen to locate in California, are performing well enough to increase employment, and are growing faster than elsewhere thus increasing their regional competitive strength.

A competitive industry that is growing in relative employment concentration while experiencing job losses implies that employment in this industry in the nation as a whole is also declining, but at a faster rate. In this instance, the state has evident advantages for businesses in the industry that shields them from unsuitable conditions experienced elsewhere. However, it is also an indication that the industry as a whole is on a structural downward employment trend. Industries in California that fit into this category include those related to fashion, and some electrical equipment manufacturing

Simultaneous declines in employment and industry concentration is revealing. These industries are clearly experiencing some types of barriers. Businesses are choosing to leave the region or are encountering conditions that have caused them to contract employment. In addition, industry employment is either increasing in other regions, or is at least declining at a slower rate. Industries in California that have lost competitiveness since 2002 and have also lost employment include those related to aerospace parts and instrumentation, machinery manufacturing and some transportation equipment manufacturing.

A competitive industry that has declined in relative employment concentration while experiencing job gains implies that the concentration of this industry in the nation as a whole is increasing faster than that of the state. The implication is that the region is missing an opportunity to capitalize on existing strength and is losing its competitive edge to other regions. The only industry in this category is machine shops. This is an industry that is in the supply chain for many other manufacturing industries and its increases in employment are a positive sign for the competitiveness of other industries.

Exhibit 4-5
Competitive Manufacturing Industries: Winners and Losers
California

NAICS	Industry	Employment in 2012	2012 LQ
Industries That Are Growing More Concentrated and Are Getting Larger			
3121	Beverage manufacturing	44,446	2.2
3119	Other food manufacturing	25,183	1.3
3254	Pharmaceutical and medicine mfg	44,229	1.4
3391	Medical equipment and supplies mfg	53,331	1.5
3115	Dairy product manufacturing	17,243	1.1
Industries That Are Growing More Concentrated but Getting Smaller			
3118	Bakeries / tortilla manufacturing	40,133	1.2
3241	Petroleum / coal products manufacturing	14,651	1.1
3169	Other leather / allied product mfg	2,322	1.7
3133	Textile / fabric finishing / coating mills	6,195	1.6
3351	Electric lighting eqmt manufacturing	6,769	1.3
3343	Audio & video equipment manufacturing	6,546	2.8
3346	Mfg / repro magnetic / optical media	5,386	2.3
3342	Communications eqmt manufacturing	27,090	2.1
3341	Computer / peripheral equipment mfg	60,833	3.2
3152	Cut and sew apparel manufacturing	53,182	3.8
Industries That Have Lost Concentration and Are Getting Smaller			
3369	Other transportation eqmt manufacturing	3,200	0.8
3159	Apparel accessories / other apparel mfg	1,885	1.3
3379	Other furniture products manufacturing	3,681	0.9
3332	Industrial machinery manufacturing	14,051	1.2
3328	Coating/engraving / heat treating / allied	15,298	1.0
3114	Fruit / vegetable preserving / spec foods	30,636	1.6
3364	Aerospace product / parts manufacturing	70,482	1.2
3333	Commercial / service industry machinery	10,206	1.1
3345	Navigational / measuring / electromed / control instruments mfg	81,603	1.8
3344	Semiconductor / other electr components	88,818	2.0
Industries That Have Lost Concentration but Are Getting Larger			
3327	Machine shops / screw, nut & bolt mfg	41,736	1.0

For a complete list of location quotients for 2002 to 2012 for all industry subsectors and industry groups, see Exhibits A-1 and A-2 in the Appendix. ❖

Exhibit 4-6
Manufacturing Industries by Technological Intensity

High Technology Industries
Aircraft and spacecraft
Pharmaceuticals
Office and computer and electronic products
Radio, TV and communications equipment
Medical, precision and optical instruments

Medium-High Technology Industries
Electrical machinery and apparatus
Motor vehicles, trailers and semi-trailers
Chemicals (excluding pharmaceuticals)
Railroad equipment and transport equipment
Machinery and equipment

Medium-Low Technology Industries
Building and repairing of ships and boats
Rubber and plastics products
Coke, refined petroleum products and nuclear fuel
Other non-metallic mineral products
Basic metals and fabricated metal products

Low Technology Industries
Wood, pulp, paper, paper products, printing and publishing
Food products, beverages and tobacco
Textiles, textile products, leather and footwear
Other manufacturing

Exhibit 4-7
Manufacturing Employment by Technological Intensity
United States and California 2012

	2012	% of all mfg	02-12 %Δ since 2002
United States:			
High Technology	2,151,032	18.1	-14.3%
Medium-High Technology	2,848,816	23.9	-21.2%
Medium-Low Technology	2,916,380	24.5	-17.4%
Low Technology	3,989,075	33.5	-28.2%
Total Manufacturing	11,905,303	100.0	-21.7%
California:			
High Technology	432,932	34.7	-16.7%
Medium-High Technology	158,569	12.7	-30.6%
Medium-Low Technology	232,389	18.7	-22.9%
Low Technology	422,061	33.9	-27.8%
Total Manufacturing	1,245,951	100.0	-23.7%

Technological Intensity

As manufacturing becomes more automated, digitized, computer-aided and capital intensive, competitiveness will become a matter of how nimble, innovative and technologically advanced a company and its industry is.

From a single firm's perspective, gaining an edge on the competition requires being more efficient, being more productive, innovating products and processes, and investing in new technology and high-skilled employees.

For a regional economy, maintaining a competitive edge in a global economy requires an aggregation of competitive firms and industries. Therefore regional competitiveness can be measured by the proportion of its employment that is involved in more highly technological manufacturing processes.

In 1997, the Organisation for Economic Co-operation and Development (OECD) developed taxonomy for manufacturing industries based on the level of technology used or produced. The thinking behind this initiative was that technology is a critical factor in productivity growth, and identifying technology-intensive industries is needed to analyze a region's overall competitiveness and performance outlook.

Since those early efforts, the taxonomy has been refined several times. Under the current methodology, technological intensity is measured by an industry's expenditures on research and development (R&D) as a share of the total value of production. An industry that invests more of its revenues back into research and development is likely to innovate and discover new products and processes, and be at the forefront of their competitiveness frontier.

The result is a categorization of manufacturing industries into high technology, medium-high technology, medium-low technology and low technology groups (Exhibit 4-6).

Using this categorization, employment by technological intensity can be compared across regions. A region with relatively more of its manufacturing employment in high technology and medium-high technology manufacturing is more likely to be able to compete globally, to win new markets, to pay higher wages and to increase the wealth of its resident population.

Across the United States, 18.1 percent of manufacturing employment is in high technology industries, 23.9

percent is in medium-high technology industries, 24.5 percent is in medium-low technology industries and 33.5 percent is in low technology industries (Exhibit 4-7).

California's employment is relatively more concentrated in high and medium-high technology industries, but similar to the nation as a whole, more than one-third of manufacturing employment is in low technology industries.

Technological intensity may have a mixed effect when it comes to employment, however, as some technology can be used by workers to increase their productivity, but other types may replace workers altogether. Lower technology industries experience a higher rate of employment loss as they are more exposed to automation and off-shoring.

Although virtually all manufacturing industries lost employment since 2002, high technology industries experienced a slower rate of employment loss than all other types of technological intensity (Exhibit 4-7).

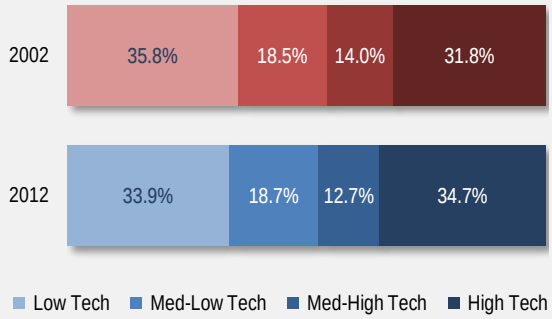
Still, given the mix of industries in the state, California's loss of manufacturing employment during the ten-year period was higher than the national average.

The differential rates of employment declines across technological intensities resulted in a slight change in the distribution of employment across categories in the manufacturing sector over the period, such that high-technology intensity manufacturing increased its share of employment by nearly two percentage points at the expense of low-technology intensive employment (Exhibit 4-8). This suggests an improvement in California's competitive position as it increases its overall technological intensity and high tech focus.

Higher levels of R&D that are associated with high technological intensities are correlated with higher capital-to-labor ratios as well, thus labor productivity is expected to be higher and workers are better compensated. In fact, employees in high technology manufacturing earned a wage premium of $66,350 on average over all other manufacturing in 2012 (Exhibit 4-9).

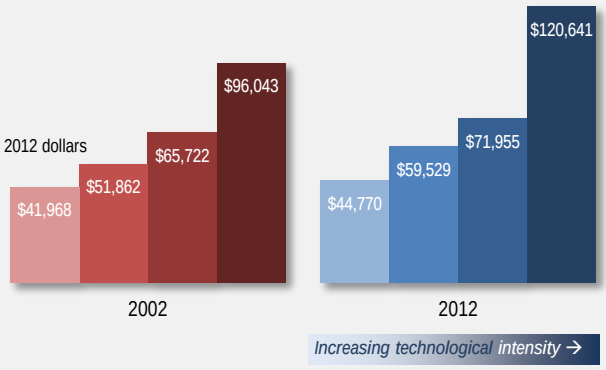
Moreover, the change in real wages from 2002 to 2012 was greater in high technology industries, increasing by 25.6 percent from 2002 to 2012, compared to an increase of only 6.7 percent in low technology industries. ❖

Exhibit 4-8
Manufacturing Employment by Tech Intensity
California 2002 and 2012



Technology intensity in manufacturing has been increasing, with almost half of manufacturing employment in California in high-tech and medium-high tech industries, compared to 46 percent in 2002.

Exhibit 4-9
Annual Wage in Manufacturing by Tech Intensity
California 2002 and 2012



Workers in high-tech manufacturing in California earned on average $66,350 more in 2012 than other manufacturing workers.

5 Key Manufacturing Industry Clusters in California

Through ground-breaking work done at the Institute for Strategy and Competitiveness at Harvard Business School, and supported by the Economic Development Administration of the U.S. Department of Commerce, Professor Michael E. Porter's Cluster Mapping Project has established a nationally-consistent grouping of industries into clusters based on several measures of relatedness, such as the use of labor and inputs, and geographic co-location patterns.

Industry clusters are known to be important for driving regional competitiveness, as firms in clusters can more easily learn from each other, share infrastructure, spur innovation and operate more efficiently—all factors which can lower costs, improve product and service quality, and increase the industry's ability to gain market share, leading to expansion and job creation.

The Cluster Mapping Project identifies 51 *traded* industry clusters, which are industries that are likely to sell their products and services to other regions and nations, and sixteen *local* industry clusters, which primarily serve the local market.

In reality, the industry clusters that are the strongest in California, in terms of employment concentration and therefore also competitiveness, are agricultural inputs and services and the entertainment industry cluster (Exhibit 5-1). The first is resource-based with broad concentration in the Central Valley, the most productive agricultural region in the nation. The entertainment industry cluster is largely in Southern California given its historic roots, but has deep connection to the software and visual effects industries in Silicon Valley. Other competitive traded clusters include information technology and analytical instruments (concentrated in Silicon Valley) and communication equipment and services (much of which is in San Diego and Orange County).

In this section, the top twelve manufacturing industry clusters (by employment) are described and their competitive position reviewed. They appear in alphabetical order (Exhibit 5-2).

Exhibit 5-1
Competitive Industry Clusters in CA 2012

Cluster Name	Employment	LQ
Agricultural Inputs and Services	195,650	4.9
Entertainment	174,170	2.8
Information Technology / Analytical Instruments	267,510	2.1
Communications Equipment and Services	66,730	1.5
Fashion	79,650	1.5
Biomedical	93,400	1.5
Aerospace Vehicles and Defense	103,560	1.5
Food Processing and Manufacturing	147,380	1.3
Marketing, Design and Publishing	178.550	1.3
Recreational and Small Electric Goods	24,090	1.2
Education and Knowledge Creation	312,430	1.2
Business Services	937,440	1.1
Environmental Services	13,060	1.1

Exhibit 5-2
Key Manufacturing Industry Clusters in California

Aerospace Vehicles and Defense

Once one of the strongest industry clusters in California, with broad and deep supplier networks in Southern California, the aerospace vehicles and defense industry cluster has faced challenges. This cluster includes establishments that manufacture aircraft, space vehicles, guided missiles, and related parts, as well as firms that manufacture the necessary search and navigation equipment used by these products.

Exhibit 5-3
Aerospace Vehicles and Defense Industry Cluster
California 2002 and 2012

	2012	2002	%Δ
Establishments	748	882	-15.2%
Employment	103,555	126,389	-18.1%
% of CA total employment	*0.7*	*0.9*	*-18.7%*
% of US cluster employment	*16.5*	*20.6*	*-20.1%*
Average annual wages ($2012)	$103,326	$ 92,419	11.8%
Employment LQ	1.5	1.8	-18.6%

The loss of defense spending in the 1990s led to significant employment declines in these industries across the state, exacerbated by the relocation of manufacturing to other states and nations. The more recent trend towards commercialization has renewed opportunities for growth, but the industry remains dependent on government contracts.

The decline in employment of 18.1 percent over the ten years was exceeded by a decline in the employment concentration, indicating that although employment fell throughout the nation, California has lost some competitive edge to other regions in this industry. Still, the cluster employed more than 100,000 highly-paid workers in 2012, accounting for 16.5 percent of all aerospace jobs in the nation. More than eighty percent of these workers are employed in Southern California.

Aerospace and aviation continue to be significant drivers of innovation through their unique needs for increased efficiencies and their ability to invest in ever newer materials and processes.

Biomedical

A combination of biopharmaceuticals and medical devices, the biomedical industry cluster is at the forefront of advances in the delivery of innovative and revolutionary products to enhance human well-being and improve health outcomes. The industry cluster includes the manufacturing of surgical, dental and optical instruments and supplies, and of chemical and biological substances used in medications, vaccines, diagnostic tests and other medical applications.

Exhibit 5-4
Biomedical Industry Cluster
California 2002 and 2012

	2012	2002	%Δ
Establishments	1,393	1,544	-9.8%
Employment	93,404	90,199	3.6%
% of CA total employment	*0.6*	*0.6*	*2.7%*
% of US cluster employment	*16.9*	*16.0*	*5.3%*
Average annual wages ($2012)	$108,904	$ 84,708	28.6%
Employment LQ	1.5	1.4	7.2%

Consolidation of the industry over the past ten years is evidenced by the decline in establishments accompanied by an increase in employment. While still relatively small, the cluster has increased in competitiveness and is expected to continue to grow in strength amid continued investment and the regional presence of industry leaders.

California currently employs almost 17 percent of all workers in this industry cluster across the nation—more than half of whom are in Southern California.

Advances in bioengineering, nanotechnology and the miniaturization of medical devices will continue, bringing new products and technologies to market. Supplemented and strengthened by cutting edge research conducted at the numerous research universities in California, this industry is poised for growth and California is well-positioned to remain competitive in this industry cluster.

Communications Equipment and Services

Although much of this cluster is involved in providing communication services, such as satellite telecommunications, cable and subscription programming and wireless telecommunication services, which are ubiquitous, the manufacture of communication equipment is strong in some regions of the state.

Exhibit 5-5
Communications Equipment and Services Industry Cluster
California 2002 and 2012

	2012	2002	%Δ
Establishments	2,313	2,493	-7.2%
Employment	66,726	91,709	-27.2%
% of CA total employment	*0.4*	*0.6*	*-27.8%*
% of US cluster employment	*17.2*	*18.3*	*-6.1%*
Average annual wages ($2012)	$100,918	$ 90,826	11.1%
Employment LQ	1.5	1.6	-4.4%

The combination of service providers and equipment manufacturers, both of which have experienced consolidation and workforce reductions, this cluster has lost almost 30 percent of its employment over the past ten years as the manufacture of semiconductors and electronic components was off-shored to lower cost nations, and as the digital delivery of software decimated reproduction and media production. Although it continues to maintain competitive strength, this has waned since 2002.

This is an industry cluster that is and has been in transition due to technological improvements, changes in consumer behavior and content delivery methods.

Fashion

Home to Hollywood and the entertainment industry, California has long been a leader in fashion design and manufacturing, with famous celebrities showcasing the most innovative and extravagant fashion trends on the red carpet and on the screen. More recently, the trends toward fast fashion and the state's position as a gateway to the factory floor in Southeast Asia have cemented its prominence in the fashion industry.

Exhibit 5-6
Fashion Industry Cluster
California 2002 and 2012

	2012	2002	%Δ
Establishments	4,365	7,682	-43.2%
Employment	79,645	137,952	-42.3%
% of CA total employment	*0.5*	*0.9*	*-42.7%*
% of US cluster employment	*17.2*	*14.2*	*21.2%*
Average annual wages ($2012)	$ 35,965	$ 30,381	18.4%
Employment LQ	1.5	1.2	23.4%

Fashion industries continue to shed jobs as the low value-added of apparel manufacturing migrates to the lower-cost nations of Southeast Asia—as well as to lower-cost regions of the United States. Industries in this cluster have suffered among the largest job losses (by percentage) of all manufacturing industries, losing more than 40 percent of all establishments and employment over the ten year period. The remaining concentration of employment in California allows the state to maintain its competitive advantage, but the outlook is dismal for this industry cluster. Almost ninety percent of current employment in fashion is located in Southern California.

A potential area for growth is the incorporation of new materials into the fabric of clothing, including biometric devices that monitor the behavior and physical responses of the wearer. Such advances have already been made, in particular, for use in athletic and sporting wear. Manufacturing this type of fabric and clothing will require investment in new machinery and higher-skilled labor, and as such it is not clear that the industry as it is currently resourced has a competitive edge in the emergence of advanced material fabric manufacturing and assembly.

Food Processing and Manufacturing

Firms in this industry cluster are involved in processing raw food and manufacturing food products for end users. This includes: rice, corn, flour and sugar millers and refiners; baked goods manufacturing; cookies and crackers, bakeries and tortillas; candies and snack foods; milk and dairy products; pet food manufacturing; and breweries and wineries. It is one of the largest industry clusters in the state, employing almost 150,000 workers in 2012.

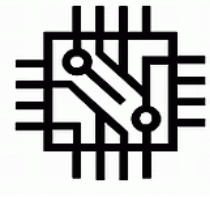
Exhibit 5-7
Food Processing and Manufacturing Industry Cluster
California 2002 and 2012

	2012	2002	%Δ
Establishments	3,326	2,854	16.5%
Employment	147,382	140,627	4.8%
% of CA total employment	*1.0*	*0.9*	*3.9%*
% of US cluster employment	*15.0*	*14.7*	*2.1%*
Average annual wages ($2012)	$ 50,473	$ 48,248	4.6%
Employment LQ	1.3	1.3	4.0%

The growth in establishments outpaced the growth in employment over the past ten years, suggesting an increase in small businesses in this industry cluster. Continued growth over the past ten years also suggest that much of this manufacturing is less exposed to automation and capital substitution or outsourcing. The explosion of micro breweries and wineries has made beverage manufacturing one of the fastest growing industries in the state. However, industry wages reflect the lower value of these manufactured goods, as the average wage in this cluster falls below the state average wage across all industries.

Food processing is often responsive to the size of the population. For example, beverage manufacturing and bottling will almost always occur near the final consumer to minimize transportation costs to market. Other foods, however, are sold on the world market. California continues to retain competitiveness in this industry cluster.

Information Technology and Analytical Instruments



This cutting edge industry cluster consists of firms engaged in the manufacturing of computers, audio visual equipment, laboratory instruments and some medical instrumentation, as well as the precision electronics used in the manufacture of these products, such as circuit boards and semiconductor devices. The cluster also includes software publishers and software reproduction. Many of its establishments are clustered in Silicon Valley and Silicon Beach.

Exhibit 5-8
Information Technology / Analytical Instruments Industry Cluster
California 2002 and 2012

	2012	2002	%Δ
Establishments	4,398	5,864	-25.0%
Employment	267,509	337,530	-20.7%
% of CA total employment	*1.8*	*2.3*	*-21.4%*
% of US cluster employment	*23.3*	*23.9*	*-2.4%*
Average annual wages ($2012)	$143,232	$108,542	31.6%
Employment LQ	2.1	2.1	-0.6%

Manufacturing industries in this cluster have lost establishments and jobs over the ten year period, but California retains its competitive edge. More than 267,500 highly-paid workers were employed here in 2012, accounting for more than 23 percent of all jobs in this industry cluster across the nation. Almost two-thirds of these are located in Northern California.

This is another high technology industry cluster that is continually in transition. While advances occur in one area, such as development of more advanced electronics and the explosion of cloud computing and social media, destruction occurs elsewhere, such as the adoption of digital delivery and the virtual elimination of media reproduction. This industry cluster is the epitome of transformative processes.

Metalworking Technology

The metalworking industry cluster is the backbone of machining capability in the region, consisting of firms that manufacture the machine tools and the process the metal used in metal working. Also in this cluster are the many firms engaged in manufacturing metal fasteners used in aerospace and hand tools used across manufacturing industries.

Exhibit 5-9
Metalworking Technology Industry Cluster
California 2002 and 2012

	2012	2002	%Δ
Establishments	2,175	2,846	-23.6%
Employment	43,889	52,510	-16.4%
% of CA total employment	*0.3*	*0.4*	*-17.1%*
% of US cluster employment	*8.8*	*8.9*	*-1.1%*
Average annual wages ($2012)	$ 50,684	$ 48,455	4.6%
Employment LQ	0.8	0.8	0.7%

The heavy industrial regions of Southern California account for more than 80 percent of the state's employment in this industry cluster. Although the number of firms fell at the same rate as the average for all manufacturing, employment losses were slower, implying a consolidation of operations in larger companies.

The state does not have a competitive edge overall in these industries. Individual counties do, however, given the geographic concentration of the cluster in the south of the state.

Oil and Gas Production and Transportation

As the nation's third largest crude oil producing state and third largest refining state, the oil and gas industry, although small in terms of employment, is a critical part of the California economy. This cluster combines extraction, refining and the transportation of oil and gas, as well as companies that provide support services for pipelines and oil and gas operations.

Exhibit 5-10
Oil and Gas Production and Transportation Industry Cluster
California 2002 and 2012

	2012	2002	%Δ
Establishments	873	930	-6.1%
Employment	40,467	32,176	25.8%
% of CA total employment	*0.3*	*0.2*	*24.7%*
% of US cluster employment	*5.2*	*6.8*	*-24.1%*
Average annual wages ($2012)	$152,349	$103,112	47.8%
Employment LQ	0.5	0.6	-22.7%

Employment in the industry cluster grew by more than 25 percent over the ten year period, and in 2012 paid an average annual wage exceeding $150,000.

While other regions of the nation have seen significant increases in employment as a result of the application of enhanced recovery techniques, California has lagged behind in increasing production, yielding a decline in relative competitiveness as other states have gained strength and a smaller share of the national cluster employment.

Plastics

Firms in this industry cluster manufacture plastic materials, components and products, such as bottles, pipes and floor covering. Also included are firms manufacturing plastics and foam used in packaging, and firms manufacturing the industrial machines used to manufacture plastics. Many firms are suppliers to automobile manufacturers and the medical device industry.

Exhibit 5-11
Plastics Industry Cluster
California 2002 and 2012

	2012	2002	%Δ
Establishments	1,252	1,677	-25.3%
Employment	42,932	60,829	-29.4%
% of CA total employment	*0.3*	*0.4*	*-30.0%*
% of US cluster employment	*7.2*	*8.1*	*-10.2%*
Average annual wages ($2012)	$ 49,089	$ 45,020	9.0%
Employment LQ	0.6	0.7	-8.5%

Another manufacturing industry cluster that has experienced job losses over the ten-year period, the rate of job losses exceeded job losses in this industry cluster elsewhere in the nation, costing a ten percent decline in California's share of national cluster employment.

Although the state does not appear to be competitive in this industry cluster, its products are vitally important for several other industries, including automobile and aerospace parts, medical devices and beverage manufacturing. This industry is also at the forefront of incorporating advanced materials such as composites into products. Investments that yield improvements in process assessment and compression will improve the state's competitiveness.

Production Technology and Heavy Machinery

The production technology and heavy machinery industry cluster is a critical supplier to most manufacturing industries, consisting of firms that manufacture the machines that produce parts and devices used for industrial, agricultural, construction and commercial industries. This includes the manufacture of machinery used in textiles, food processing, sawmills, packaging, construction, engines, farm machinery, mining, industrial patterns, industrial processes, pumps, ball bearings, and more.

Exhibit 5-12
Production Technology and Heavy Machinery
California 2002 and 2012

	2012	2002	%Δ
Establishments	1,786	2,178	-18.0%
Employment	51,807	62,042	-16.5%
% of CA total employment	*0.3*	*0.4*	*-17.2%*
% of US cluster employment	*5.6*	*6.0*	*-6.8%*
Average annual wages ($2012)	$ 70,048	$ 62,148	12.7%
Employment LQ	0.5	0.5	-5.0%

This industry cluster has not been particularly strong competitively in California and has experienced job losses over the ten-year period, although at a slower rate than all other manufacturing industries.

More than 80 percent of the employment is located in the industrial areas of Southern California. Jobs at all skill levels are represented in these industries, with relatively high average wages.

Recreational and Small Electric Goods

Establishments in the recreational and small electric goods industry cluster manufacture products for recreational and decorative purposes, such as games, toys, bicycles, musical instruments, sporting goods, art supplies and home accessories. Also included are firms that produce small uncomplicated electronic goods such as hair dryers and fans.

Exhibit 5-13
Recreational and Small Electric Goods Industry Cluster
California 2002 and 2012

	2012	2002	%Δ
Establishments	1,456	1,811	-19.6%
Employment	24,091	41,475	-41.9%
% of CA total employment	*0.2*	*0.3*	*-42.4%*
% of US cluster employment	*13.9*	*14.4*	*-3.2%*
Average annual wages ($2012)	$ 60,197	$ 52,462	14.7%
Employment LQ	1.2	1.2	-1.4%

For the most part, firms in these industries are small businesses, which have been hard hit by the decline in domestic manufacturing employment. The loss of almost 42 percent of jobs over the ten-year period and almost 20 percent of the establishment suggests that the companies that remain are larger.

This cluster has maintained its competitive strength in California compared to the nation in spite of the significant employment decline, buoyed by its concentration of musical instrument manufacturers and firms that manufacture sporting and athletic goods.

Almost 75 percent of the employment in this cluster is located in Southern California. ❖

6 Southern California in Detail

The discussion of industry clusters revealed a diversity of geographic concentration among industries and regions. Some industries are more concentrated in the south of the state, while others are found in the north. A more detailed picture is needed to better understand regional strengths and opportunities.

The industrial makeup of manufacturing is markedly different in the north than in the south. The Southern California sub-region consists of sixteen counties which lie south of Fresno; the remaining counties are aggregated into the Northern California sub-region. These two halves of the state are summarized in the following pages.

Thereafter, a detailed picture of seven counties in Southern California (Imperial, Los Angeles, Orange, Riverside, San Bernardino, San Diego and Ventura) is provided.

For each county, the following data is reviewed:

- A ten-year trend of manufacturing employment in the county;
- Manufacturing employment and establishments by industry subsector in 2012;
- The 25 largest manufacturing industry groups (by employment);
- A listing of all competitive manufacturing industry groups in the county, measured by a location quotient equal to or greater than 1.1, and its change since 2002;
- Manufacturing employment by technological intensity for 2002 and 2012; and
- Average annual manufacturing wages by technological intensity for 2002 and 2012.

Exhibit 6-1
California's Sub-Regions

Northern California Sub-Region

- More than one-third of the state's manufacturing employment is in Northern California, accounting for more than 430,000 jobs and almost 8 percent of the region's overall employment.
- Manufacturing in Northern California is concentrated in the high technology industries related to computers, software, communications equipment and pharmaceuticals. More than 55 percent of all manufacturing employment is in high technology or medium-high technology industries.
- The region's manufacturing competitiveness has been on the rise since 2002 in most of its manufacturing industries.

Exhibit 6-3
Manufacturing Employment by Tech Intensity
Northern Cal ifornia 2002 and 2012

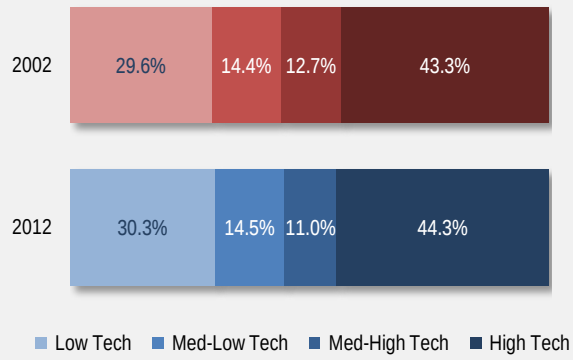


Exhibit 6-2
Manufacturing Employment by Subsector
Northern California Sub-Region 2012

NAICS	Industry	Employment	Establish-ments
311	Food manufacturing	56,550	1,309
312	Beverage / tobacco products	28,369	1,061
313	Textile mills	407	47
314	Textile product mills	1,126	157
315	Apparel manufacturing	3,001	246
316	Leather and allied products	595	39
321	Wood products	10,216	367
322	Paper	5,549	136
323	Printing and support activities	11,046	995
324	Petroleum / coal products	8,212	83
325	Chemicals	25,303	591
326	Plastics / rubber products	7,337	280
327	Nonmetallic mineral products	11,467	473
331	Primary metal	5,128	137
332	Fabricated metal products	29,990	1,880
333	Machinery	23,353	810
334	Computer / electronic products	151,641	1,773
335	Electrical equipment / appliances	7,689	305
336	Transportation equipment	17,347	318
337	Furniture and related products	6,787	652
339	Miscellaneous manufacturing	20,196	1,258
Total Manufacturing		431,308	12,914
Percent of Sub-Region Total		*7.9%*	*2.6%*
Percent of CA Manufacturing		*34.6%*	*32.5%*

Exhibit 6-4
Competitive Manufacturing Industries by Location Quotient
Northern California Sub-Region 2012

NAICS	Industry	LQ	Change since 2002
3341	Computer and peripheral equipment mfg	7.1	↑
3346	Manufacturing / reproducing magnetic and optical media	4.4	↑
3121	Beverage mfg	3.9	↑
3344	Semiconductor / other electronic components	3.5	↓
3342	Communications equipment mfg	3.3	↑
3343	Audio and video equipment mfg	2.6	↑
3332	Industrial machinery mfg	2.2	↑
3114	Fruit / vegetable preserving / specialty foods	2.2	↓
3241	Petroleum and coal products mfg	1.8	↑
3254	Pharmaceutical and medicine mfg	1.7	↑
3345	Navigational / measuring / electromedical / control instruments mfg	1.6	↓
3113	Sugar and confectionery product mfg	1.2	↓
Total Manufacturing		0.9	↑

Southern California Sub-Region

- With two-thirds of the state's manufacturing employment, Southern California employs more than 814,000 manufacturing workers, accounting for 8.6 percent of all employment.
- Manufacturing in Southern California is very diverse, with a combination of low technology manufacturing industries in fashion and food, and high technology manufacturing in aerospace parts and instrumentation, computer and electronic components, and medical devices.
- This diversity in manufacturing provides Southern California with both challenges and opportunities as it considers its competitive strengths in industries that may be on the decline.

Exhibit 6-6
Manufacturing Employment by Tech Intensity
CMTC SoCal 2002 and 2012

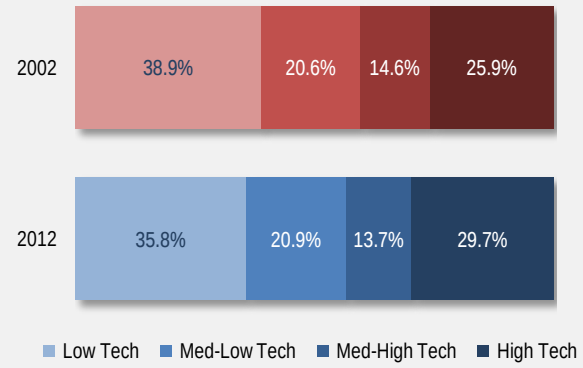


Exhibit 6-5
Manufacturing Employment by Subsector
Southern California Sub-Region 2012

NAICS	Industry	Employment	Establish-ments
311	Food manufacturing	92,564	2,155
312	Beverage / tobacco products	16,115	460
313	Textile mills	8,286	322
314	Textile product mills	7,191	469
315	Apparel manufacturing	53,572	2,661
316	Leather and allied products	2,873	116
321	Wood products	9,149	534
322	Paper	15,765	360
323	Printing and support activities	31,083	2,295
324	Petroleum / coal products	6,439	153
325	Chemicals	50,509	1,192
326	Plastics / rubber products	36,966	953
327	Nonmetallic mineral products	16,704	728
331	Primary metal	14,650	408
332	Fabricated metal products	93,436	4,311
333	Machinery	47,410	1,844
334	Computer / electronic products	118,635	2,074
335	Electrical equipment / appliances	21,324	667
336	Transportation equipment	84,584	1,246
337	Furniture and related products	24,736	1,395
339	Miscellaneous manufacturing	62,651	2,540
Total Manufacturing		814,738	26,883
Percent of Sub-Region Total		*8.6%*	*3.2%*
Percent of CA Manufacturing		*65.4%*	*67.5%*

Exhibit 6-7
Competitive Manufacturing Industries by Location Quotient
Southern California Sub-Region 2012

NAICS	Industry	LQ	Change since 2002
3152	Cut and sew apparel mfg	5.8	↑
3343	Audio and video equipment mfg	3.0	↑
3169	Other leather and allied product mfg	2.4	↑
3133	Textile / fabric finishing / fabric coating mills	2.4	↑
3345	Navigational / measuring / electromedical / control instruments mfg	1.9	↓
3391	Medical equipment and supplies mfg	1.8	↑
3159	Apparel accessories and other apparel mfg	1.8	↓
3364	Aerospace product and parts mfg	1.7	↓
3351	Electric lighting equipment mfg	1.6	↓
3342	Communications equipment mfg	1.5	↑
3119	Other food mfg	1.4	↑
3118	Bakeries and tortilla mfg	1.3	↓
3254	Pharmaceutical and medicine mfg	1.3	↑
3151	Apparel knitting mills	1.3	↑
3121	Beverage mfg	1.3	↑
3115	Dairy product mfg	1.3	↑
3328	Coating / engraving / heat treating / allied	1.3	↓
3114	Fruit / vegetable preserving / specialty foods	1.3	↓
3256	Soap / cleaning compound / toilet preparation	1.2	↑
3333	Commercial / service industry machinery mfg	1.2	↓
3344	Semiconductor / other electronic components	1.2	↑
3327	Machine shops; screw, nut and bolt mfg	1.2	↓
3399	Other miscellaneous mfg	1.2	↓
3325	Hardware mfg	1.2	↓
3379	Other furniture related product mfg	1.2	↓
3346	Manufacturing / reproducing magnetic and optical media	1.2	↓
Total Manufacturing		1.0	↓

Imperial County

- Imperial County is largely an agricultural county with little by way of manufacturing. Manufacturing employment in Imperial County, most of which is related to food processing, averaged 2,658 in 2012, accounting for 4.5 percent of county employment.
- With so few jobs in the manufacturing sector, there was very little to shed during the past decade, and only 164 manufacturing jobs were lost.
- Animal processing and manufacture of lime and gypsum products (such as construction materials wallboard and plaster) are the largest manufacturing industries in the county, both of which are very competitive relative to the national average.
- As a result of its industry mix, manufacturing in Imperial County is mostly in low technology industries.

Exhibit 6-9
Manufacturing Employment
Imperial County
(in thousands)

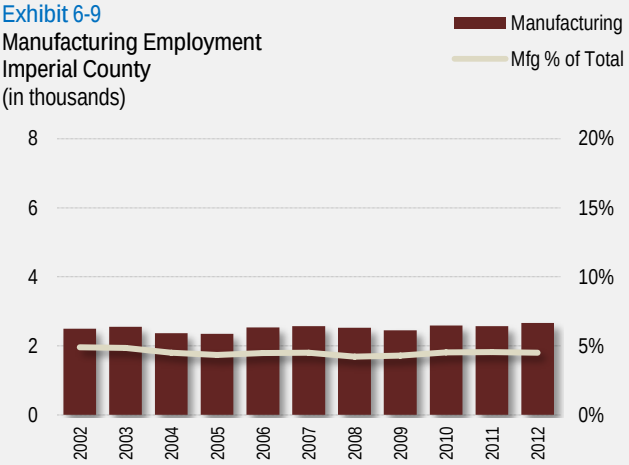
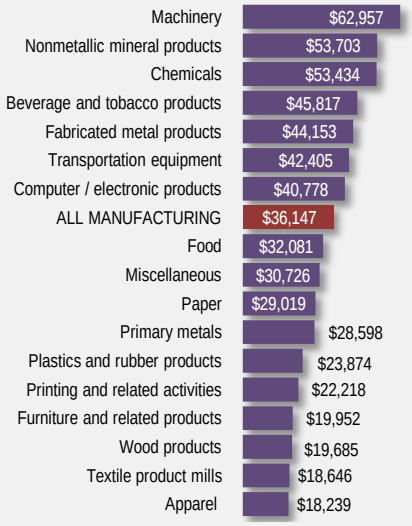


Exhibit 6-8
Average Annual Wages in Manufacturing
Imperial County 2012



The annual average wage in manufacturing industries in Imperial County was $36,147 in 2012.

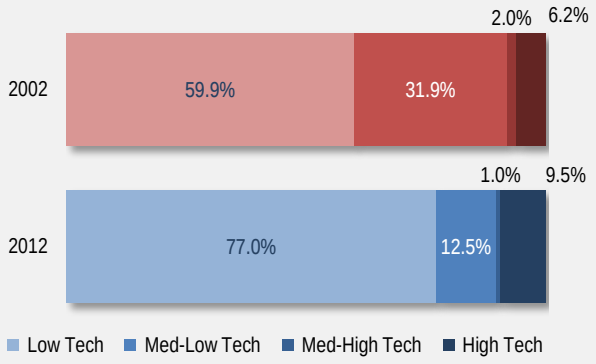
Exhibit 6-10
Manufacturing Employment by Subsector
Imperial County 2012

NAICS	Industry	Employment	Establish-ments
311	Food manufacturing	1,825	14
312	Beverage / tobacco products	99	4
313	Textile mills	-	-
314	Textile product mills	-	1
315	Apparel manufacturing	3	3
316	Leather and allied products	-	-
321	Wood products	1	2
322	Paper	25	2
323	Printing and support activities	7	1
324	Petroleum / coal products	-	-
325	Chemicals	2	1
326	Plastics / rubber products	1	1
327	Nonmetallic mineral products	286	4
331	Primary metal	1	1
332	Fabricated metal products	43	7
333	Machinery	23	5
334	Computer / electronic products	64	4
335	Electrical equipment / appliances	-	-
336	Transportation equipment	176	2
337	Furniture and related products	1	1
339	Miscellaneous manufacturing	100	8
Total Manufacturing		2,658	61
Percent of County Total		*4.5%*	*0.9%*
Percent of CA Manufacturing		*0.2%*	*0.2%*

Exhibit 6-11
Largest Manufacturing Industries by Employment
Imperial County 2012

NAICS	Industry	Employ-ment	% of MFG
3116	Animal slaughtering and processing	1,468	55.2%
3274	Lime / gypsum product mfg	207	7.8%
3364	Aerospace product and parts mfg	175	6.6%
3111	Animal food mfg	109	4.1%
3121	Beverage mfg	99	3.7%
3113	Sugar and confectionery product mfg	87	3.3%
3399	Other miscellaneous mfg	86	3.2%
3273	Cement / concrete product mfg	79	3.0%
3118	Bakeries and tortilla mfg	73	2.7%
3115	Dairy product mfg	72	2.7%
3345	Navigational / measuring / electromedical / control instruments mfg	40	1.5%
3329	Other fabricated metal product mfg	35	1.3%
3222	Converted paper product mfg	25	1.0%
3344	Semiconductor / other electr components	19	0.7%
3119	Other food mfg	16	0.6%
3331	Ag / construction / mining machinery mfg	15	0.6%
3391	Medical equipment and supplies mfg	14	0.5%
3231	Printing and related support activities	7	0.3%
3327	Machine shops; screw, nut and bolt mfg	7	0.3%
3339	Other general purpose machinery mfg	6	0.2%
3341	Computer and peripheral equipment mfg	5	0.2%
3152	Cut and sew apparel mfg	3	0.1%
3335	Metalworking machinery mfg	2	0.1%
3256	Soap / cleaning compound / toilet preparation mfg	2	0.1%
3261	Plastics product mfg	2	0.1%
All other manufacturing industries		*6*	*0.2%*
Total Manufacturing		2,658	100.0

Exhibit 6-12
Manufacturing Employment by Tech Intensity
Imperial County 2002 and 2012

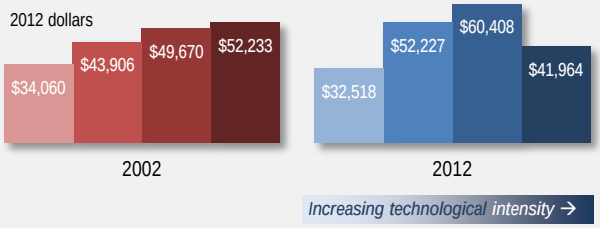


Manufacturing in Imperial County is predominantly in the low technology industries related to various types of food and nonmetallic mineral processing.

Exhibit 6-13
Competitive Manufacturing Industries by Location Quotient
Imperial County 2012

NAICS	Industry	LQ	Change since 2002
3274	Lime / gypsum product mfg	32.7	↓
3116	Animal slaughtering and processing	6.8	↑
3111	Animal food mfg	4.6	↓
3113	Sugar and confectionery product mfg	2.8	↓
3121	Beverage mfg	1.2	↑
3115	Dairy product mfg	1.2	↑
3273	Cement / concrete product mfg	1.1	↑
Total Manufacturing		0.5	↑

Exhibit 6-14
Annual Wage in Manufacturing by Tech Intensity
Imperial County 2002 and 2012



With the small number of high technology manufacturing workers, there is a wage premium instead on the medium-high technology work.

Los Angeles County

- Los Angeles County continues to be a manufacturing powerhouse, with more than 365,500 jobs in manufacturing industries in 2012, accounting for 9.2 percent of county employment and 29.3 percent of all manufacturing employment in California.
- Almost 169,000 manufacturing jobs were lost between 2002 and 2012, a decline of 31.6 percent over the decade.
- Los Angeles County is most competitive in manufacturing industries in the fashion cluster, but also maintains competitive strength in the sophisticated instrumentation and other parts used in the aerospace industry and a wide variety of high technology and durable goods industries.
- Manufacturing in Los Angeles County overall is relatively low in technological intensity given its strength in fashion and apparel, food processing and fabricated metals.

Exhibit 6-16
Manufacturing Employment
Los Angeles County
(in thousands)

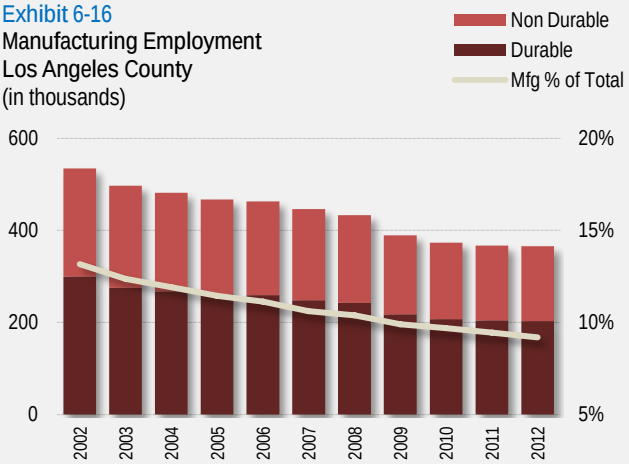
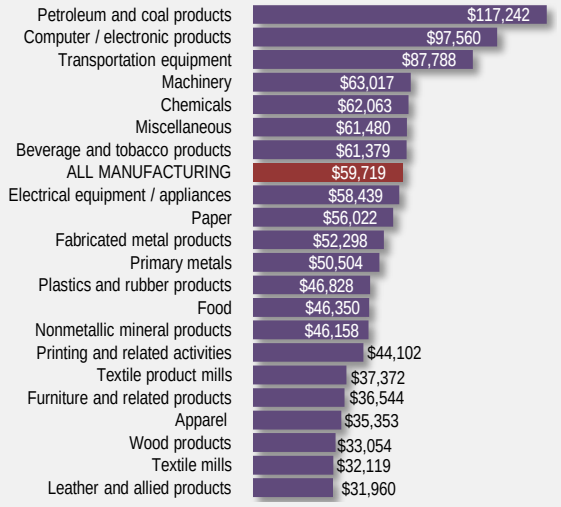


Exhibit 6-15
Average Annual Wages in Manufacturing
Los Angeles County 2012



The annual average wage in manufacturing industries in Los Angeles County was $59,719 in 2012.

Exhibit 6-17
Manufacturing Employment by Subsector
Los Angeles County 2012

NAICS	Industry	Employment	Establish-ments
311	Food manufacturing	39,179	1,024
312	Beverage / tobacco products	5,138	68
313	Textile mills	6,732	256
314	Textile product mills	3,993	208
315	Apparel manufacturing	45,617	2,231
316	Leather and allied products	2,256	76
321	Wood products	3,023	218
322	Paper	7,041	152
323	Printing and support activities	14,786	1,068
324	Petroleum / coal products	4,154	68
325	Chemicals	19,856	518
326	Plastics / rubber products	13,558	381
327	Nonmetallic mineral products	5,357	255
331	Primary metal	7,126	207
332	Fabricated metal products	42,956	1,913
333	Machinery	16,297	734
334	Computer / electronic products	41,528	650
335	Electrical equipment / appliances	9,548	275
336	Transportation equipment	46,212	532
337	Furniture and related products	13,126	640
339	Miscellaneous manufacturing	18,043	1,007
Total Manufacturing		365,525	12,480
Percent of County Total		*9.2%*	*3.0%*
Percent of CA Manufacturing		*29.3%*	*31.5%*

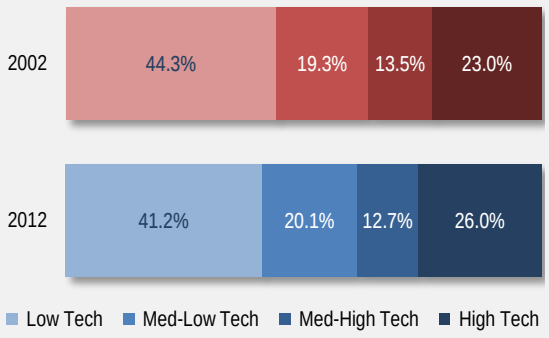
Exhibit 6-18
Largest Manufacturing Industries by Employment
Los Angeles County 2012

NAICS	Industry	Employ-ment	% of MFG
3152	Cut and sew apparel mfg	43,933	12.0%
3364	Aerospace product and parts mfg	38,474	10.5%
3345	Navigational / measuring / electromedical / control instruments mfg	26,280	7.2%
3118	Bakeries and tortilla mfg	15,844	4.3%
3231	Printing and related support activities	14,796	4.0%
3327	Machine shops; screw, nut and bolt mfg	14,449	4.0%
3261	Plastics product mfg	11,895	3.3%
3399	Other miscellaneous mfg	9,495	2.6%
3371	HH / institutionl furniture / kitchen cabinet	8,939	2.4%
3391	Medical equipment and supplies mfg	8,543	2.3%
3344	Semiconductor / other electr components	8,512	2.3%
3329	Other fabricated metal product mfg	7,309	2.0%
3254	Pharmaceutical and medicine mfg	7,155	2.0%
3328	Coating / engraving / heat treating / allied	6,827	1.9%
3222	Converted paper product mfg	6,745	1.8%
3256	Soap / cleaning compound / toilet prep	6,682	1.8%
3323	Architectural and structural metals mfg	6,636	1.8%
3119	Other food mfg	6,565	1.8%
3121	Beverage mfg	5,137	1.4%
3133	Textile / fabric finishing / coating mills	5,028	1.4%
3339	Other general purpose machinery mfg	4,827	1.3%
3115	Dairy product mfg	4,696	1.3%
3363	Motor vehicle parts mfg	4,545	1.2%
3116	Animal slaughtering and processing	4,513	1.2%
3241	Petroleum and coal products mfg	4,154	1.1%
All other manufacturing industries		*83,604*	*22.9%*
Total Manufacturing		365,583	100.0

Exhibit 6-20
Competitive Manufacturing Industries by Location Quotient
Los Angeles County 2012

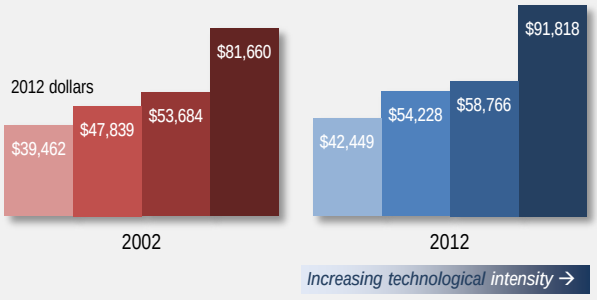
NAICS	Industry	LQ	Change since 2002
3152	Cut and sew apparel mfg	11.9	↑
3133	Textile / fabric finishing / fabric coating mills	4.8	↑
3169	Other leather and allied product mfg	4.5	↑
3159	Apparel accessories and other apparel mfg	3.4	↓
3364	Aerospace product and parts mfg	2.6	↓
3345	Navigational / measuring / electromedical / control instruments mfg	2.2	↓
3256	Soap / cleaning compound / toilet preparation	2.2	↑
3118	Bakeries and tortilla mfg	1.9	↑
3351	Electric lighting equipment mfg	1.7	↓
3346	Manufacturing / reproducing magnetic and optical media	1.7	↑
3328	Coating / engraving / heat treating / allied	1.7	↓
3379	Other furniture related product mfg	1.5	↓
3162	Footwear mfg	1.5	↑
3325	Hardware mfg	1.4	↓
3141	Textile furnishings mills	1.4	↓
3371	HH / institutional furniture / kitchen cabinet	1.3	↓
3327	Machine shops; screw, nut and bolt mfg	1.3	↓
3343	Audio and video equipment mfg	1.3	↓
3119	Other food mfg	1.3	↑
3333	Commercial / service industry machinery mfg	1.2	↓
3241	Petroleum and coal products mfg	1.2	↓
3115	Dairy product mfg	1.2	↓
3399	Other miscellaneous mfg	1.2	↓
3321	Forging and stamping	1.2	↑
3359	Other electrical equipment / component mfg	1.1	↑
Total Manufacturing		1.0	↓

Exhibit 6-19
Manufacturing Employment by Tech Intensity
Los Angeles County 2002 and 2012



Technology intensity in manufacturing has been increasing, with almost half of all employment in high-tech and medium-high tech industries, compared to 46 percent in 2002.

Exhibit 6-21
Annual Wage in Manufacturing by Tech Intensity
Los Angeles County 2002 and 2012



Workers in high-tech manufacturing in Los Angeles County earned on average $43,360 more in 2012 than other manufacturing workers.

Orange County

- Manufacturing employment in Orange County averaged 157,748 in 2012, accounting for more than 11 percent of county employment and 12.7 percent of all manufacturing employment in the state.
- Almost 33,300 manufacturing jobs were lost between 2002 and 2012, a decline of 17.4 percent over the ten-year span.
- Orange County is competitive in a diverse set of industries, including communications equipment, computer and electronic components, medical devices, pharmaceuticals, metalworking, apparel and machinery manufacturing.
- Manufacturing in Orange County is concentrated in high technology industries, resulting in higher wages for employees and stronger competitiveness.

Exhibit 6-23
Manufacturing Employment
Orange County
(in thousands)

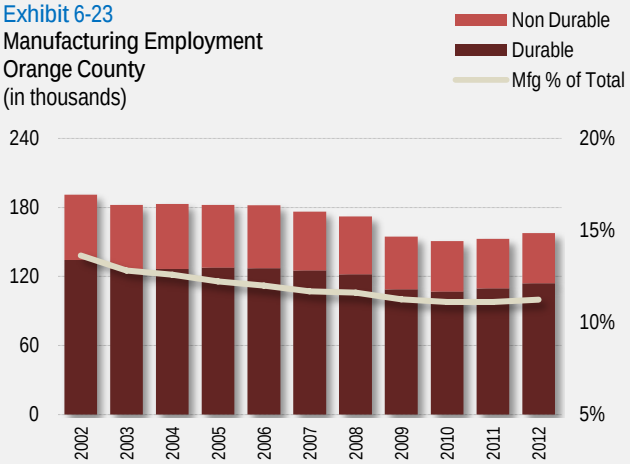
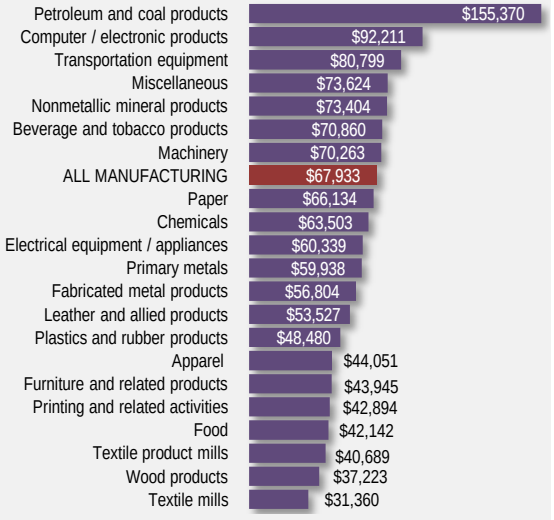


Exhibit 6-22
Average Annual Wages in Manufacturing
Orange County 2012



The annual average wage in manufacturing industries in Orange County was $67,933 in 2012.

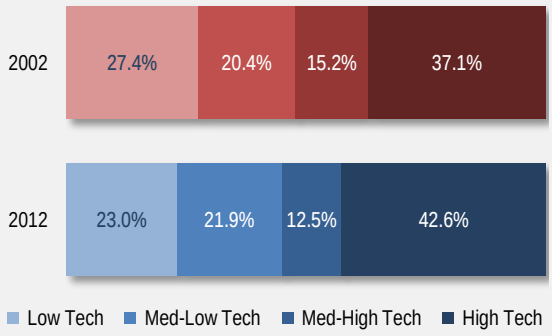
Exhibit 6-24
Manufacturing Employment by Industry
Orange County 2012

NAICS	Industry	Employment	Establish-ments
311	Food manufacturing	6,945	262
312	Beverage / tobacco products	1,186	25
313	Textile mills	745	30
314	Textile product mills	1,328	85
315	Apparel manufacturing	5,550	235
316	Leather and allied products	260	12
321	Wood products	1,361	88
322	Paper	2,918	71
323	Printing and support activities	8,194	472
324	Petroleum / coal products	398	19
325	Chemicals	7,927	219
326	Plastics / rubber products	8,340	186
327	Nonmetallic mineral products	1,521	90
331	Primary metal	1,118	41
332	Fabricated metal products	22,298	869
333	Machinery	9,217	370
334	Computer / electronic products	34,313	570
335	Electrical equipment / appliances	4,631	156
336	Transportation equipment	13,705	226
337	Furniture and related products	3,774	197
339	Miscellaneous manufacturing	22,020	527
Total Manufacturing		157,748	4,745
Percent of County Total		*11.2%*	*4.7%*
Percent of CA Manufacturing		*12.7%*	*12.0%*

Exhibit 6-25
Largest Manufacturing Industries by Employment
Orange County 2012

NAICS	Industry	Employ-ment	% of MFG
3391	Medical equipment and supplies mfg	18,070	11.5%
3344	Semiconductor / other electr components	13,618	8.6%
3345	Navigational / measuring / electromedical / control instruments mfg	11,890	7.5%
3364	Aerospace product and parts mfg	10,301	6.5%
3327	Machine shops; screw, nut and bolt mfg	8,690	5.5%
3231	Printing and related support activities	8,194	5.2%
3261	Plastics product mfg	6,655	4.2%
3341	Computer and peripheral equipment mfg	6,341	4.0%
3152	Cut and sew apparel mfg	4,649	2.9%
3254	Pharmaceutical and medicine mfg	4,318	2.7%
3399	Other miscellaneous mfg	3,954	2.5%
3329	Other fabricated metal product mfg	3,611	2.3%
3323	Architectural and structural metals mfg	3,366	2.1%
3328	Coating / engraving / heat treating / allied	3,216	2.0%
3339	Other general purpose machinery mfg	2,885	1.8%
3222	Converted paper product mfg	2,553	1.6%
3118	Bakeries and tortilla mfg	2,534	1.6%
3371	HH / institutionl furniture / kitchen cabinet	2,351	1.5%
3119	Other food mfg	2,346	1.5%
3335	Metalworking machinery mfg	2,343	1.5%
3363	Motor vehicle parts mfg	2,073	1.3%
3353	Electrical equipment mfg	1,939	1.2%
3262	Rubber product mfg	1,685	1.1%
3333	Commercial / service industry machinery	1,676	1.1%
3321	Forging and stamping	1,628	1.0%
All other manufacturing industries		*26,928*	*17.1%*
Total Manufacturing		157,814	100.0

Exhibit 6-26
Manufacturing Employment by Tech Intensity
Orange County 2002 and 2012

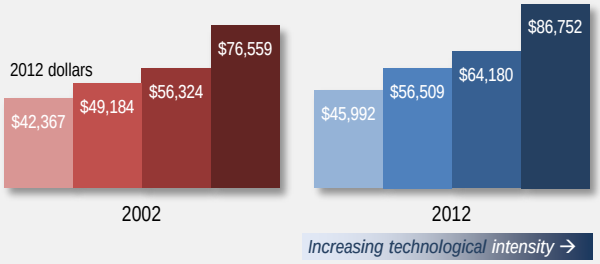


Technological intensity in manufacturing has been increasing, with more than 55 percent of all employment in high-tech and medium-high tech industries.

Exhibit 6-27
Competitive Manufacturing Industries by Location Quotient
Orange County 2012

NAICS	Industry	LQ	Change since 2002
3151	Apparel knitting mills	5.6	↑
3391	Medical equipment and supplies mfg	5.5	↑
3343	Audio and video equipment mfg	5.5	↑
3152	Cut and sew apparel mfg	3.6	↑
3341	Computer and peripheral equipment mfg	3.6	↑
3344	Semiconductor / other electronic components	3.3	↑
3325	Hardware mfg	2.9	↑
3345	Navigational / measuring / electromedical / control instruments mfg	2.8	↓
3369	Other transportation equipment mfg	2.5	↑
3327	Machine shops; screw, nut and bolt mfg	2.3	↑
3328	Coating / engraving / heat treating / allied ac	2.2	↓
3351	Electric lighting equipment mfg	2.0	↑
3364	Aerospace product and parts mfg	2.0	↓
3333	Commercial / service industry machinery mfg	1.9	↑
3231	Printing and related support activities	1.7	↑
3255	Paint / coating / adhesive mfg	1.7	↑
3321	Forging and stamping	1.6	↓
3133	Textile / fabric finishing / fabric coating mills	1.5	↑
3254	Pharmaceutical and medicine mfg	1.5	↓
3399	Other miscellaneous mfg	1.4	↑
3271	Clay product and refractory mfg	1.3	↑
3342	Communications equipment mfg	1.3	↓
3353	Electrical equipment mfg	1.3	↓
3119	Other food mfg	1.3	↑
3329	Other fabricated metal product mfg	1.3	↑
3372	Office furniture (including fixtures) mfg	1.3	↓
3335	Metalworking machinery mfg	1.2	↑
3262	Rubber product mfg	1.2	↑
3261	Plastics product mfg	1.2	↓
3169	Other leather and allied product mfg	1.2	↓
Total Manufacturing		1.2	↑

Exhibit 6-28
Annual Wage in Manufacturing by Tech Intensity
Orange County 2002 and 2012

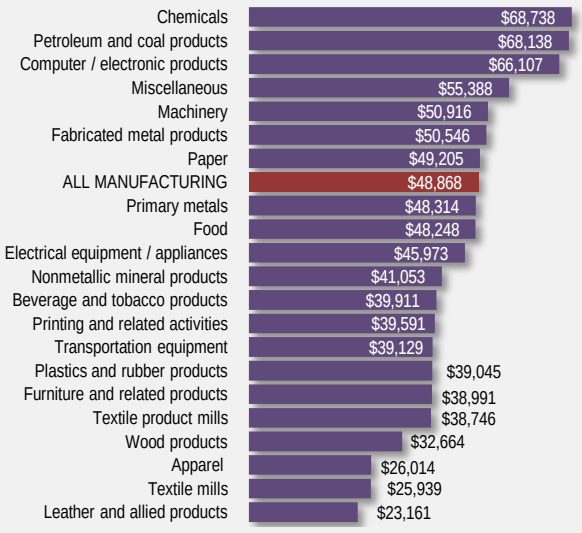


Workers in high-tech manufacturing in Orange County earned on average $32,800 more in 2012 than other manufacturing workers.

Riverside County

- Manufacturing employment in Riverside County averaged 39,010 in 2012, accounting for less than 7 percent of county employment.
- More than 9,800 manufacturing jobs were lost between 2002 and 2012, a decline of more than 20 percent over the decade.
- Riverside County is very competitive in a variety of durable goods manufacturing industries, including: medical devices and pharmaceuticals; plastics; toys, sporting goods and musical instruments; navigational and satellite instrumentation used in aerospace; fabricated and ornamental metals; and motor vehicle and aerospace parts.
- Manufacturing in Riverside County is concentrated in low and medium-low technology industries, although this has changed substantially over the past ten years to become more high technology manufacturing.

Exhibit 6-29
Average Annual Wages in Manufacturing
Riverside County 2012



The annual average wage in manufacturing industries Riverside County in 2012 was $48,868.

Exhibit 6-30
Manufacturing Employment
RiversideCounty
(in thousands)

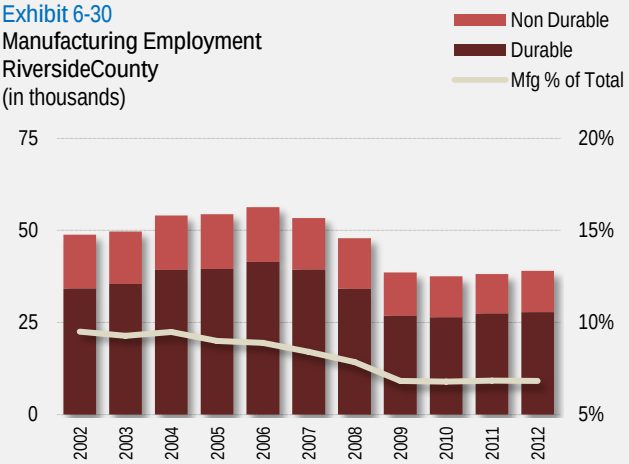


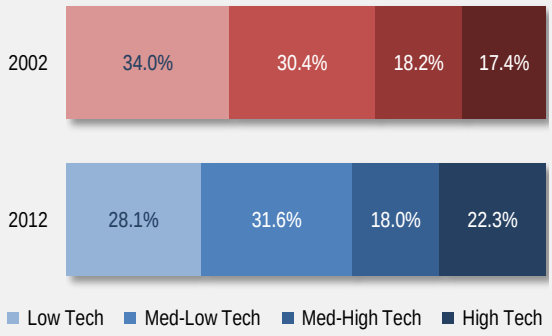
Exhibit 6-31
Manufacturing Employment by Industry
Riverside County 2012

NAICS	Industry	Employment	Establish-ments
311	Food manufacturing	1,606	89
312	Beverage / tobacco products	1,541	39
313	Textile mills	51	3
314	Textile product mills	337	30
315	Apparel manufacturing	156	22
316	Leather and allied products	5	3
321	Wood products	1,566	49
322	Paper	722	17
323	Printing and support activities	1,252	98
324	Petroleum / coal products	178	4
325	Chemicals	2,232	70
326	Plastics / rubber products	3,162	67
327	Nonmetallic mineral products	2,239	81
331	Primary metal	1,027	26
332	Fabricated metal products	5,727	271
333	Machinery	2,521	124
334	Computer / electronic products	3,302	63
335	Electrical equipment / appliances	1,146	38
336	Transportation equipment	3,190	91
337	Furniture and related products	1,402	71
339	Miscellaneous manufacturing	5,649	160
All Manufacturing		39,010	1,412
Percent of County Total		*6.8%*	*2.9%*
Percent of CA Manufacturing		*3.1%*	*3.6%*

Exhibit 6-32
Largest Manufacturing Industries by Employment
Riverside County 2012

NAICS	Industry	Employ-ment	% of MFG
3391	Medical equipment and supplies mfg	3,474	8.9%
3261	Plastics product mfg	2,711	6.9%
3399	Other miscellaneous mfg	2,179	5.6%
3323	Architectural and structural metals mfg	1,999	5.1%
3121	Beverage mfg	1,541	3.9%
3344	Semiconductor / other electr components	1,521	3.9%
3345	Navigational / measuring / electromedical / control instruments mfg	1,470	3.8%
3273	Cement / concrete product mfg	1,358	3.5%
3363	Motor vehicle parts mfg	1,308	3.4%
3231	Printing and related support activities	1,252	3.2%
3254	Pharmaceutical and medicine mfg	1,217	3.1%
3327	Machine shops; screw, nut and bolt mfg	1,186	3.0%
3329	Other fabricated metal product mfg	1,010	2.6%
3339	Other general purpose machinery mfg	844	2.2%
3219	Other wood product mfg	784	2.0%
3222	Converted paper product mfg	722	1.8%
3364	Aerospace product and parts mfg	705	1.8%
3362	Motor vehicle body and trailer mfg	700	1.8%
3212	Veneer / plywood / enginr'd wood prods	671	1.7%
3353	Electrical equipment mfg	596	1.5%
3118	Bakeries and tortilla mfg	575	1.5%
3372	Office furniture (including fixtures) mfg	570	1.5%
3313	Alumina / aluminum production / proc	564	1.4%
3371	HH / institutionl furniture / kitchen cabinet	472	1.2%
3359	Other electrical equipment / components	468	1.2%
All other manufacturing industries		*9,134*	*23.4%*
Total Manufacturing		39,031	100.0

Exhibit 6-33
Manufacturing Employment by Tech Intensity
Riverside County 2002 and 2012

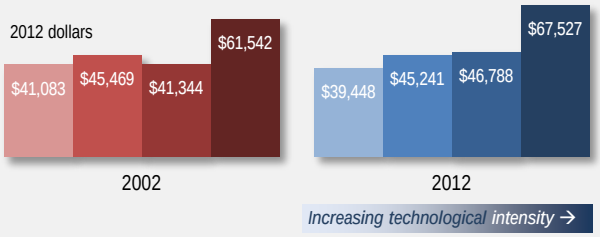


Manufacturing in Riverside County has been relatively low technology but has increased since 2002, with over 40 percent of employment in high and medium-high technology manufacturing in 2012.

Exhibit 6-34
Competitive Manufacturing Industries by Location Quotient
Riverside County 2012

NAICS	Industry	LQ	Change since 2002
3379	Other furniture related product mfg	2.9	↑
3391	Medical equipment and supplies mfg	2.6	↓
3212	Veneer / plywood / engineered wood prods	2.5	↑
3313	Alumina / aluminum production / processing	2.3	↓
3121	Beverage mfg	2.0	↑
3326	Spring and wire product mfg	2.0	↑
3273	Cement / concrete product mfg	1.9	↑
3399	Other miscellaneous mfg	1.9	↑
3369	Other transportation equipment mfg	1.7	↓
3271	Clay product and refractory mfg	1.6	↓
3323	Architectural and structural metals mfg	1.3	--
3372	Office furniture (including fixtures) mfg	1.3	↓
3325	Hardware mfg	1.3	↑
3333	Commercial / service industry machinery mfg	1.3	↑
3362	Motor vehicle body and trailer mfg	1.3	↓
3261	Plastics product mfg	1.2	↓
Total Manufacturing		0.8	--

Exhibit 6-35
Annual Wage in Manufacturing by Tech Intensity
Riverside County 2002 and 2012



Workers in high-tech manufacturing in Riverside County earned on average $24,200 more in 2012 than other manufacturing workers.

San Bernardino County

- Manufacturing employment in San Bernardino County averaged 47,254 in 2012, accounting for 7.7 percent of county employment.
- More than 17,750 manufacturing jobs were lost between 2002 and 2012, a decline of more than 27 percent over the decade.
- Like its Inland Empire neighbor, San Bernardino County manufacturing employment is in many subsectors, most of which manufacture durable goods.
- San Bernardino County is most competitive in plastics, cement and concrete products, furniture, fabricated metals and machine shops.
- Manufacturing in San Bernardino County is low in technological intensity, resulting in higher wages for employees and stronger competitiveness.

Exhibit 6-37
Manufacturing Employment
San Bernardino County
(in thousands)

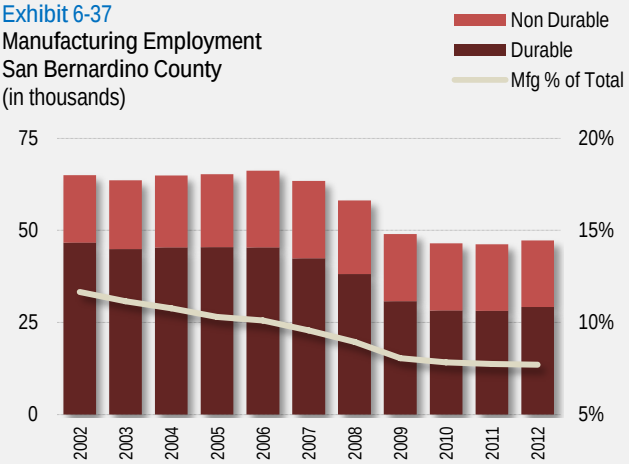
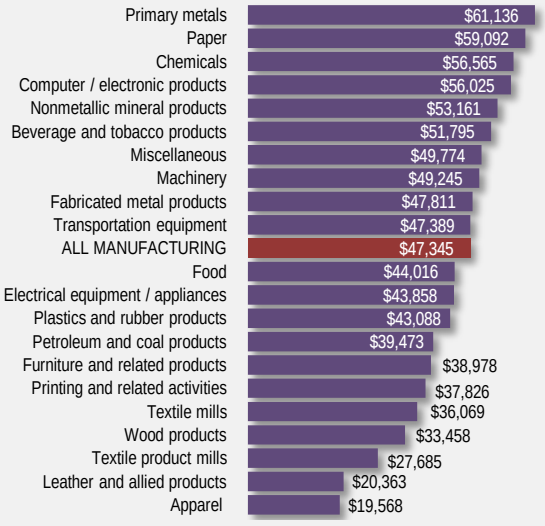


Exhibit 6-36
Average Annual Wages in Manufacturing
San Bernardino County 2012



The annual average wage in manufacturing industries in San Bernardino County in 2012 was $47,345.

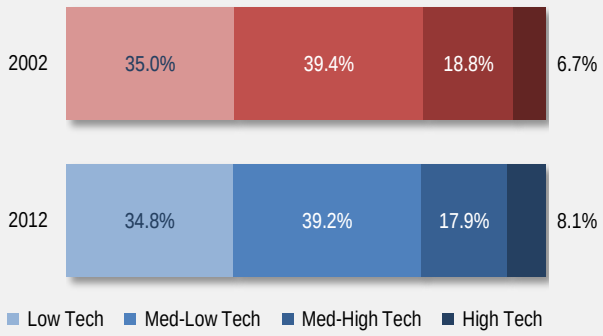
Exhibit 6-38
Manufacturing Employment by Industry
San Bernardino County 2012

NAICS	Industry	Employment	Establish-ments
311	Food manufacturing	5,641	123
312	Beverage / tobacco products	1,095	17
313	Textile mills	193	9
314	Textile product mills	624	31
315	Apparel manufacturing	289	37
316	Leather and allied products	---	---
321	Wood products	1,569	72
322	Paper	1,137	34
323	Printing and support activities	1,187	128
324	Petroleum / coal products	---	---
325	Chemicals	2,433	87
326	Plastics / rubber products	5,124	123
327	Nonmetallic mineral products	2,775	88
331	Primary metal	3,345	56
332	Fabricated metal products	6,931	326
333	Machinery	3,104	152
334	Computer / electronic products	1,596	74
335	Electrical equipment / appliances	1,643	42
336	Transportation equipment	2,879	100
337	Furniture and related products	3,107	108
339	Miscellaneous manufacturing	2,213	133
All Manufacturing		47,254	1,752
Percent of County Total		*7.7%*	*3.6%*
Percent of CA Manufacturing		*3.8%*	*4.4%*

Exhibit 6-39
Largest Manufacturing Industries by Employment
San Bernardino County 2012

NAICS	Industry	Employ-ment	% of MFG
3261	Plastics product mfg	4,539	9.6%
3273	Cement / concrete product mfg	2,325	4.9%
3118	Bakeries and tortilla mfg	2,244	4.7%
3371	HH / institutionl furniture / kitchen cabinets	2,227	4.7%
3323	Architectural and structural metals mfg	1,835	3.9%
3327	Machine shops; screw, nut and bolt mfg	1,497	3.2%
3311	Iron / steel mills and ferroalloy mfg	1,425	3.0%
3399	Other miscellaneous mfg	1,421	3.0%
3219	Other wood product mfg	1,298	2.7%
3119	Other food mfg	1,240	2.6%
3231	Printing and related support activities	1,187	2.5%
3321	Forging and stamping	1,130	2.4%
3121	Beverage mfg	1,096	2.3%
3329	Other fabricated metal product mfg	1,060	2.2%
3222	Converted paper product mfg	1,025	2.2%
3335	Metalworking machinery mfg	937	2.0%
3351	Electric lighting equipment mfg	934	2.0%
3364	Aerospace product and parts mfg	926	2.0%
3363	Motor vehicle parts mfg	902	1.9%
3391	Medical equipment and supplies mfg	793	1.7%
3251	Basic chemical mfg	746	1.6%
3334	HVAC / commercial refrigeration eqmt mfg	694	1.5%
3345	Navigational / measuring / electromedical / control instruments mfg	678	1.4%
3339	Other general purpose machinery mfg	653	1.4%
3315	Foundries	646	1.4%
	All other manufacturing industries	*13,796*	*29.2%*
	Total Manufacturing	47,254	100.0

Exhibit 6-40
Manufacturing Employment by Tech Intensity
San Bernardino County 2002 and 2012

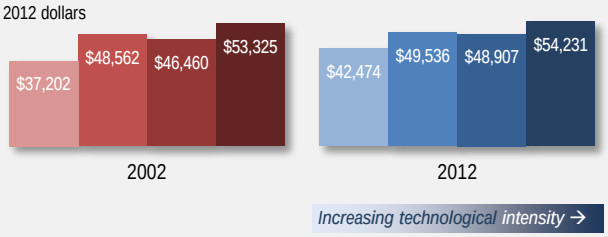


Seventy-four percent of manufacturing emplyoment in San Bernardino County is in low and medium-low technology industries.

Exhibit 6-41
Competitive Manufacturing Industries by Location Quotient
San Bernardino County 2012

NAICS	Industry	LQ	Change since 2002
3351	Electric lighting equipment mfg	4.4	↓
3311	Iron / steel mills and ferroalloy mfg	3.3	---
3273	Cement / concrete product mfg	3.0	↓
3321	Forging and stamping	2.5	↓
3379	Other furniture related product mfg	2.4	↓
3371	HH / institutional furniture / kitchen cabinets	2.2	↓
3313	Alumina / aluminum production / processing	2.0	---
3261	Plastics product mfg	1.9	↓
3112	Grain and oilseed milling	1.8	↑
3118	Bakeries and tortilla mfg	1.7	↑
3322	Cutlery and handtool mfg	1.6	↑
3119	Other food mfg	1.5	↑
3219	Other wood product mfg	1.5	↓
3312	Steel product mfg from purchased steel	1.5	↑
3141	Textile furnishings mills	1.4	↑
3121	Beverage mfg	1.3	↑
3314	Nonferrous metal production / processing	1.2	↑
3334	HVAC / commercial refrigeration equipment	1.2	↓
3323	Architectural and structural metals mfg	1.2	↓
	Total Manufacturing	0.9	↓

Exhibit 6-42
Annual Wage in Manufacturing by Tech Intensity
San Bernardino County 2002 and 2012

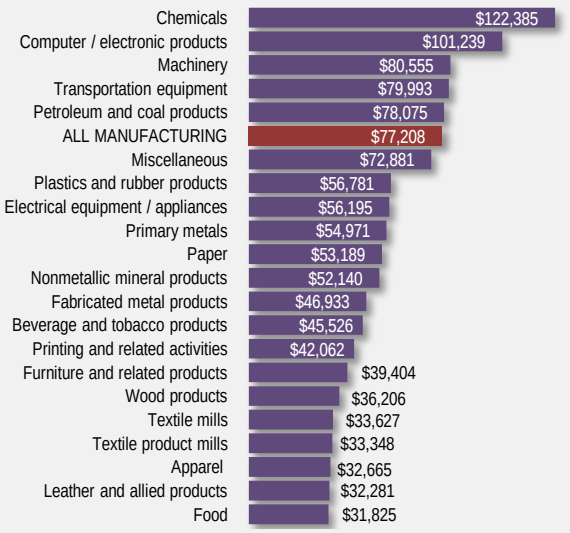


Workers in high-tech manufacturing in San Bernardino County earned on average $7,500 more in 2012 than other manufacturing workers.

San Diego County

- Manufacturing employment in San Diego County averaged 93,450 in 2012, accounting for more than 7 percent of county employment and 7.5 percent of all manufacturing employment in the state.
- More than 20,200 manufacturing jobs were lost between 2002 and 2012, a decline of almost 18 percent over the decade.
- Manufacturing wages in San Diego County averaged $77,208 in 2012, falling just below the state average manufacturing wage.
- San Diego County is highly competitive in aerospace industries, semiconductors and communication equipment, as well as medical devices and pharmaceuticals, and has improved this competitiveness since 2002.
- Manufacturing in San Diego County is highly technologically-intensive, resulting in higher wages for employees.

Exhibit 6-43
Average Annual Wages in Manufacturing
San Diego County 2012



The annual average wage in manufacturing industries isn San Diego County was $77,208, in 2012.

Exhibit 6-44
Manufacturing Employment
San Diego County
(in thousands)

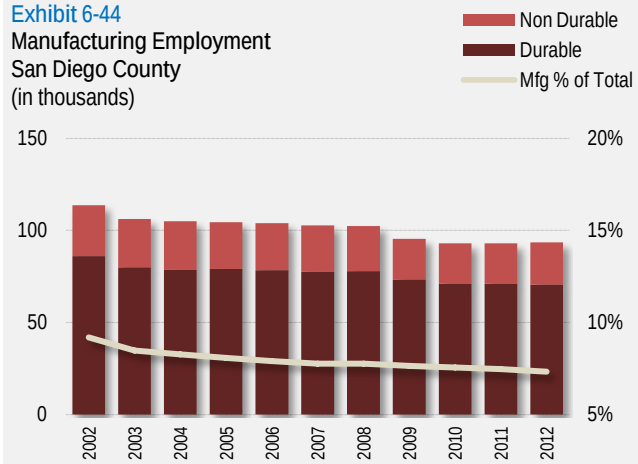


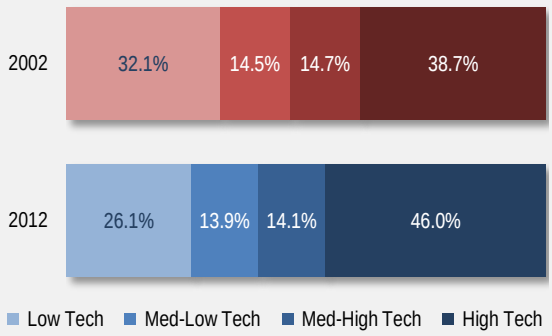
Exhibit 6-45
Manufacturing Employment by Subsector
San Diego County 2012

NAICS	Industry	Employment	Establish-ments
311	Food manufacturing	4,531	186
312	Beverage / tobacco products	1,475	23
313	Textile mills	315	12
314	Textile product mills	547	55
315	Apparel manufacturing	1,236	82
316	Leather and allied products	267	13
321	Wood products	341	44
322	Paper	783	32
323	Printing and support activities	2,936	296
324	Petroleum / coal products	79	7
325	Chemicals	7,321	159
326	Plastics / rubber products	3,387	100
327	Nonmetallic mineral products	1,503	84
331	Primary metal	839	29
332	Fabricated metal products	7,143	401
333	Machinery	8,398	191
334	Computer / electronic products	24,574	398
335	Electrical equipment / appliances	2,231	86
336	Transportation equipment	13,784	152
337	Furniture and related products	1,649	179
339	Miscellaneous manufacturing	10,111	383
Total Manufacturing		93,450	2,912
Percent of County Total		*7.3%*	*2.9%*
Percent of CA Manufacturing		*7.5%*	*7.3%*

Exhibit 6-46
Largest Manufacturing Industries by Employment
San Diego County 2012

NAICS	Industry	Employ-ment	% of MFG
3345	Navigational / measuring / electromedical / control instruments mfg	9,397	10.1%
3364	Aerospace product and parts mfg	6,770	7.2%
3366	Ship and boat building	6,144	6.6%
3391	Medical equipment and supplies mfg	5,987	6.4%
3254	Pharmaceutical and medicine mfg	5,703	6.1%
3344	Semiconductor / other electr components	5,430	5.8%
3342	Communications equipment mfg	4,361	4.7%
3399	Other miscellaneous mfg	4,124	4.4%
3336	Engine / turbine / power trans eqmt	4,060	4.3%
3118	Bakeries and tortilla mfg	3,211	3.4%
3341	Computer and peripheral equipment mfg	3,102	3.3%
3261	Plastics product mfg	2,967	3.2%
3231	Printing and related support activities	2,936	3.1%
3327	Machine shops; screw, nut and bolt mfg	2,800	3.0%
3323	Architectural and structural metals mfg	2,444	2.6%
3343	Audio and video equipment mfg	2,208	2.4%
3121	Beverage mfg	1,475	1.6%
3333	Commercial / service industry machinery	1,404	1.5%
3359	Other electrical equipment / components	1,393	1.5%
3335	Metalworking machinery mfg	1,186	1.3%
3152	Cut and sew apparel mfg	1,121	1.2%
3371	HH / institutionl furniture / kitchen cabinet	973	1.0%
3273	Cement / concrete product mfg	883	0.9%
3339	Other general purpose machinery mfg	796	0.9%
3222	Converted paper product mfg	750	0.8%
All other manufacturing industries		*11,825*	*12.7%*
Total Manufacturing		93,450	100.0

Exhibit 6-47
Manufacturing Employment by Tech Intensity
San Diego County 2002 and 2012

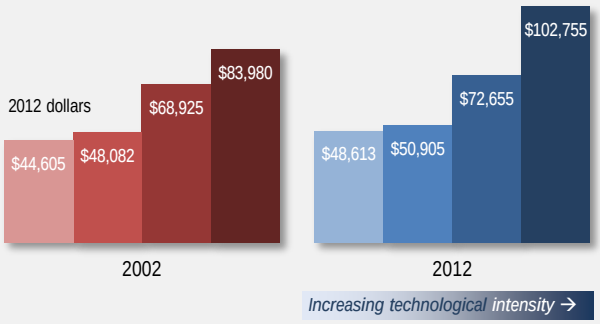


San Diego County has strengthened its high-tech industries, increasing its high- and medium-tech employment from an already significant 53.4 percent of manufacturing employment in 2002 to over 60 percent in 2012.

Exhibit 6-48
Competitive Manufacturing Industries by Location Quotient
San Diego County 2012

NAICS	Industry	LQ	Change since 2002
3343	Audio and video equipment mfg	11.2	↑
3366	Ship and boat building	4.9	↑
3342	Communications equipment mfg	4.1	↑
3336	Engine / turbine / power transmission eqmt	4.1	↑
3345	Navigational / measuring / electromedical / control instruments mfg	2.4	↑
3169	Other leather and allied product mfg	2.3	↑
3254	Pharmaceutical and medicine mfg	2.2	↑
3391	Medical equipment and supplies mfg	2.0	↑
3341	Computer and peripheral equipment mfg	1.9	↓
3333	Commercial / service industry machinery mfg	1.8	↓
3399	Other miscellaneous mfg	1.6	↓
3344	Semiconductor / other electronic components	1.5	↓
3364	Aerospace product and parts mfg	1.4	↑
3118	Bakeries and tortilla mfg	1.2	↓
Total Manufacturing		0.8	--

Exhibit 6-49
Annual Wage in Manufacturing by Tech Intensity
San Diego County 2002 and 2012

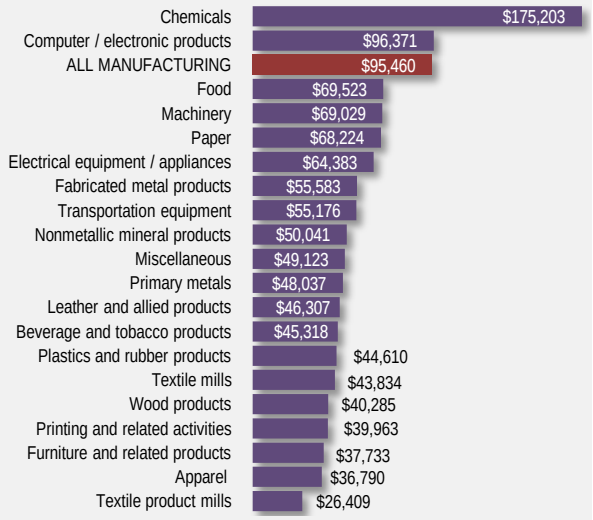


Workers in high-tech manufacturing in San Diego County earned on average $47,280 more in 2012 than other manufacturing workers.

Ventura County

- Manufacturing employment in Ventura County averaged 29,786 in 2012, accounting for almost 10 percent of county employment.
- Almost 7,800 manufacturing jobs were lost between 2002 and 2012, a decline of more than 20 percent over the decade.
- Manufacturing wages in Ventura County averaged $95,460 in 2012, buoyed by the high wages paid in chemical product manufacturing and computer and electronic components manufacturing.
- Ventura County is most competitive in industries within the two subsectors of chemical product manufacturing and computer and electronic components manufacturing.
- Manufacturing in Ventura County is highly technologically-intensive, resulting in higher wages for employees and stronger competitiveness.

Exhibit 6-50
Average Annual Wages in Manufacturing
Ventura County 2012



The annual average wage in manufacturing industries in Ventura County was $95,460 in 2012.

Exhibit 6-51
Manufacturing Employment
Ventura County
(in thousands)

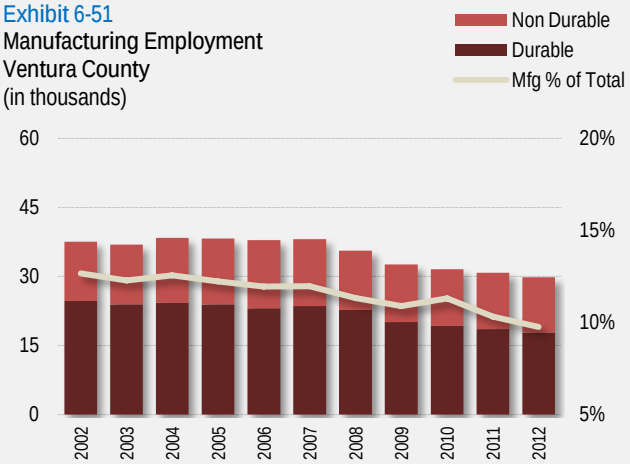


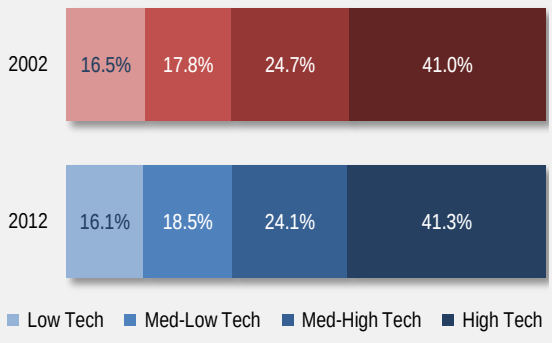
Exhibit 6-52
Manufacturing Employment by Industry Subsector
Ventura County 2012

NAICS	Industry	Employment	Establish-ments
311	Food manufacturing	996	51
312	Beverage / tobacco products	289	15
313	Textile mills	19	4
314	Textile product mills	30	14
315	Apparel manufacturing	231	10
316	Leather and allied products	17	3
321	Wood products	146	13
322	Paper	955	17
323	Printing and support activities	982	66
324	Petroleum / coal products	-	-
325	Chemicals	7,934	39
326	Plastics / rubber products	558	23
327	Nonmetallic mineral products	1,078	29
331	Primary metal	555	14
332	Fabricated metal products	3,233	174
333	Machinery	3,141	82
334	Computer / electronic products	5,374	136
335	Electrical equipment / appliances	1,241	28
336	Transportation equipment	1,300	51
337	Furniture and related products	494	41
339	Miscellaneous manufacturing	1,213	108
Total Manufacturing		29,786	918
Percent of County Total		*9.8%*	*3.9%*
Percent of CA Manufacturing		*2.4%*	*2.3%*

Exhibit 6-53
Largest Manufacturing Industries by Employment
Ventura County 2012

NAICS	Industry	Employ-ment	% of MFG
3254	Pharmaceutical and medicine mfg	5,812	19.5%
3344	Semiconductor / other electr components	2,935	9.9%
3327	Machine shops; screw, nut and bolt mfg	1,383	4.6%
3335	Metalworking machinery mfg	1,238	4.2%
3345	Navigational / measuring / electromedical / control instruments mfg	1,110	3.7%
3231	Printing and related support activities	982	3.3%
3259	Other chemical product / preparation mfg	830	2.8%
3364	Aerospace product and parts mfg	795	2.7%
3339	Other general purpose machinery mfg	722	2.4%
3342	Communications equipment mfg	690	2.3%
3391	Medical equipment and supplies mfg	632	2.1%
3279	Other nonmetallic mineral product mfg	629	2.1%
3399	Other miscellaneous mfg	581	2.0%
3253	Pesticide / fertilizer / other ag chemicals	568	1.9%
3261	Plastics product mfg	554	1.9%
3329	Other fabricated metal product mfg	550	1.8%
3222	Converted paper product mfg	544	1.8%
3351	Electric lighting equipment mfg	502	1.7%
3328	Coating / engraving / heat treating / allied	450	1.5%
3323	Architectural and structural metals mfg	447	1.5%
3315	Foundries	447	1.5%
3334	HVAC / commercial refrigeration eqmt	422	1.4%
3221	Pulp / paper / paperboard mills	411	1.4%
3353	Electrical equipment mfg	372	1.2%
3359	Other electrical equipment / components	367	1.2%
All other manufacturing industries		*5,813*	*19.5%*
Total Manufacturing		29,786	100.0

Exhibit 6-54
Manufacturing Employment by Tech Intensity
Ventura County 2002 and 2012

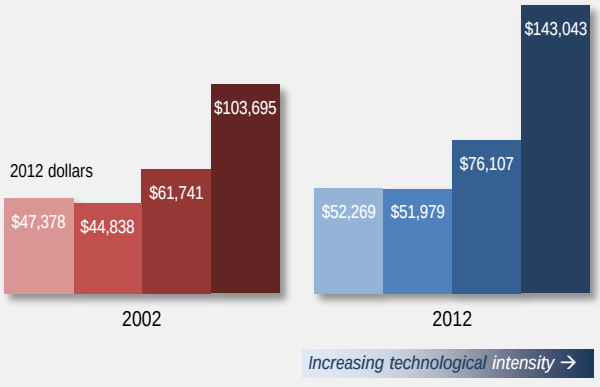


Technology intensity in manufacturing In Ventura County is (and has been) quite high, with almost two-thirds of all manufacturing employment in high and medium-high technology industries.

Exhibit 6-55
Competitive Manufacturing Industries by Location Quotient
Ventura County 2012

NAICS	Industry	LQ	Change since 2002
3254	Pharmaceutical and medicine mfg	9.3	↑
3253	Pesticide / fertilizer / other ag chemicals	6.7	↑
3346	Manufacturing / reproducing magnetic and optical media	6.6	↓
3351	Electric lighting equipment mfg	4.7	↑
3259	Other chemical product / preparation mfg	4.3	↑
3279	Other nonmetallic mineral product mfg	4.0	↑
3344	Semiconductor and other electr components	3.3	↓
3335	Metalworking machinery mfg	3.0	↑
3342	Communications equipment mfg	2.7	↑
3327	Machine shops; screw, nut and bolt mfg	1.7	↑
3221	Pulp / paper / paperboard mills	1.6	↓
3343	Audio and video equipment mfg	1.6	↓
3369	Other transportation equipment mfg	1.5	↓
3315	Foundries	1.5	↑
3334	HVAC / commercial refrigeration eqmt mfg	1.4	↑
3328	Coating / engraving / heat treating / allied	1.4	↑
3332	Industrial machinery mfg	1.4	↓
3359	Other electrical equipment / components mfg	1.2	↑
3339	Other general purpose machinery mfg	1.2	↓
3256	Soap / cleaning compound / toilet preparation	1.2	↑
3345	Navigational / measuring / electromedical / control instruments mfg	1.2	↓
Total Manufacturing		1.1	--

Exhibit 6-56
Annual Wage in Manufacturing by Tech Intensity
Ventura County 2002 and 2012



Workers in high-tech manufacturing in Ventura County earned on average $81,070 more in 2012 than other manufacturing workers.

This page intentionally left blank

Appendix

Detailed Tables

Exhibit A-1
Manufacturing in California by Industry Subsector
Change in Employment and Competitiveness 2002 to 2012

Industry Subsector		Establish-ments	Employment	Ave Annual Wage	Employment Change 2002 to 2012		Location Quotients	
					Numeric Δ	Percent	2012	2002
311	Food Manufacturing	3,463	149,114	43,525	-6,030	-3.9	0.9	0.9
312	Beverage and Tobacco Product Manufacturing	1,521	44,484	54,327	10,296	30.1	2.0	1.4
313	Textile Mills	369	8,693	33,230	-6,095	-41.2	0.6	0.4
314	Textile Product Mills	626	8,317	36,954	-9,063	-52.1	0.6	0.8
315	Apparel Manufacturing	2,907	56,573	36,152	-38,284	-40.4	3.4	2.3
316	Leather and Allied Product Manufacturing	155	3,468	35,115	-2,060	-37.3	1.0	1.0
321	Wood Product Manufacturing	901	19,365	38,911	-21,071	-52.1	0.5	0.6
322	Paper Manufacturing	495	21,314	57,522	-10,093	-32.1	0.5	0.5
323	Printing and Related Support Activities	3,290	42,129	44,038	-28,134	-40.0	0.8	0.9
324	Petroleum and Coal Products Manufacturing	236	14,651	169,313	-884	-5.7	1.2	1.1
325	Chemical Manufacturing	1,783	75,812	105,911	-4,131	-5.2	0.8	0.7
326	Plastics and Rubber Products Manufacturing	1,233	44,303	47,322	-19,285	-30.3	0.6	0.6
327	Nonmetallic Mineral Product Manufacturing	1,201	28,171	53,515	-17,820	-38.7	0.7	0.8
331	Primary Metal Manufacturing	544	19,778	56,684	-7,051	-26.3	0.4	0.5
332	Fabricated Metal Product Manufacturing	6,191	123,426	52,808	-22,078	-15.2	0.8	0.8
333	Machinery Manufacturing	2,654	70,763	77,776	-21,511	-23.3	0.6	0.7
334	Computer / Electronic Product Manufacturing	3,847	270,276	133,777	-92,039	-25.4	2.2	2.1
335	Electrical Equipment, Appliance / Component	972	29,013	63,358	-10,512	-26.6	0.7	0.7
336	Transportation Equipment Manufacturing	1,564	101,931	84,049	-35,406	-25.8	0.6	0.7
337	Furniture and Related Product Manufacturing	2,047	31,523	39,605	-36,052	-53.4	0.8	1.0
339	Miscellaneous Manufacturing	3,798	82,847	69,967	-10,704	-11.4	1.3	1.2
Total Manufacturing		39,797	1,245,951	77,345	-388,007	-23.7	0.9	0.9

Exhibit A-2
Manufacturing in California by Industry Group
Change in Employment and Competitiveness 2002 to 2012

Industry Group		Establish-ments	Employment	Ave Annual Wage	Employment Change 2002 to 2012		Location Quotients	
					Numeric Δ	Percent	2012	2002
3111	Animal food manufacturing	154	3,632	61,605	-238	-6.1	0.6	0.7
3112	Grain and oilseed milling	82	4,006	58,743	-1,210	-23.2	0.6	0.7
3113	Sugar and confectionery product mfg	177	6,161	48,332	-3,343	-35.2	0.8	1.0
3114	Fruit and vegetable preserving and specialty	313	30,636	43,645	-7,774	-20.2	1.6	1.7
3115	Dairy product manufacturing	232	17,243	65,936	831	5.1	1.1	1.0
3116	Animal slaughtering and processing	299	20,957	35,815	-360	-1.7	0.4	0.4
3117	Seafood product preparation and packaging	50	1,163	35,444	-1,366	-54.0	0.3	0.5
3118	Bakeries and tortilla manufacturing	1,653	40,133	33,590	-61	-0.2	1.3	1.2
3119	Other food manufacturing	503	25,183	44,454	7,492	42.3	1.3	1.0
3121	Beverage manufacturing	1,520	44,446	54,302	10,278	30.1	2.2	1.7
3122	Tobacco manufacturing	1	38	82,836	18	93.5	0.0	0.0
3131	Fiber, yarn, and thread mills	33	509	26,829	-172	-25.3	0.2	0.1
3132	Fabric mills	108	1,989	37,457	-2,958	-59.8	0.3	0.3
3133	Textile and fabric finishing mills	228	6,195	32,399	-2,965	-32.4	1.6	1.0
3141	Textile furnishings mills	201	3,549	35,525	-5,910	-62.5	0.6	0.7
3149	Other textile product mills	425	4,768	38,018	-3,153	-39.8	0.7	0.9
3151	Apparel knitting mills	48	1,506	38,670	-3,027	-66.8	0.9	0.8
3152	Cut and sew apparel manufacturing	2,772	53,182	35,884	-32,648	-38.0	3.8	2.7
3159	Accessories and other apparel manufacturing	87	1,885	41,703	-2,610	-58.1	1.3	1.5
3161	Leather and hide tanning and finishing	13	150	66,494	-283	-65.4	0.3	0.4
3162	Footwear manufacturing	42	996	37,027	-351	-26.1	0.6	0.6
3169	Other leather product manufacturing	100	2,322	32,268	-1,426	-38.0	1.7	1.6
3211	Sawmills and wood preservation	83	3,760	48,402	-3,985	-51.5	0.4	0.6
3212	Plywood and engineered wood product mfg	93	2,150	36,853	-4,692	-68.6	0.3	0.5
3219	Other wood product manufacturing	725	13,455	36,588	-12,394	-47.9	0.6	0.7
3221	Pulp, paper, and paperboard mills	39	1,115	68,209	-2,138	-65.7	0.1	0.2
3222	Converted paper product manufacturing	456	20,199	56,932	-7,955	-28.3	0.7	0.6
3231	Printing and related support activities	3,290	42,129	44,038	-28,134	-40.0	0.8	0.9
3241	Petroleum and coal products manufacturing	236	14,651	169,313	-884	-5.7	1.2	1.1
3251	Basic chemical manufacturing	162	4,425	73,452	-2,139	-32.6	0.3	0.3
3252	Resin, rubber, and artificial fibers mfg	149	3,044	61,116	-1,377	-31.1	0.3	0.3
3253	Agricultural chemical manufacturing	94	2,029	80,342	-591	-22.6	0.5	0.5
3254	Pharmaceutical and medicine manufacturing	500	44,229	135,190	4,235	10.6	1.4	1.2
3255	Paint, coating, and adhesive manufacturing	204	4,917	62,376	-1,110	-18.4	0.7	0.7
3256	Soap, cleaning compound, and toiletry mfg	444	11,225	62,451	-1,556	-12.2	1.0	0.9
3259	Other chemical product and preparation mfg	230	5,943	61,959	-1,594	-21.1	0.6	0.6
3261	Plastics product manufacturing	1,055	38,557	47,764	-17,991	-31.8	0.7	0.7
3262	Rubber product manufacturing	178	5,746	44,353	-1,294	-18.4	0.4	0.3
3271	Clay product and refractory manufacturing	138	2,679	51,004	-2,680	-50.0	0.6	0.6
3272	Glass and glass product manufacturing	233	6,760	52,739	-4,453	-39.7	0.7	0.8
3273	Cement and concrete product manufacturing	563	13,197	54,620	-7,579	-36.5	0.7	0.8
3274	Lime and gypsum product manufacturing	51	1,006	56,294	-855	-45.9	0.6	0.8
3279	Other nonmetallic mineral products	216	4,529	52,323	-2,252	-33.2	0.6	0.8

Exhibit A-2 (cont'd)

Industry Group		Establish-ments	Employment	Ave Annual Wage	Employment Change 2002 to 2012		Location Quotients	
					Numeric Δ	Percent	2012	2002
3311	Iron and steel mills and ferroalloy mfg	107	3,533	64,096	586	19.9	0.3	0.2
3312	Steel product mfg. from purchased steel	73	2,733	63,809	-851	-23.7	0.4	0.5
3313	Alumina and aluminum production	73	4,041	64,868	-2,461	-37.8	0.6	0.7
3314	Other nonferrous metal production	88	2,799	54,451	-775	-21.7	0.4	0.4
3315	Foundries	203	6,672	45,821	-3,551	-34.7	0.5	0.5
3321	Forging and stamping	255	9,195	56,232	-796	-8.0	0.8	0.8
3322	Cutlery and handtool manufacturing	188	2,304	44,946	-2,445	-51.5	0.5	0.6
3323	Architectural and structural metals mfg	1,281	27,387	49,050	-7,508	-21.5	0.7	0.8
3324	Boiler, tank, and shipping container mfg	149	4,911	64,709	-1,711	-25.8	0.5	0.6
3325	Hardware manufacturing	88	2,398	70,657	-2,652	-52.5	0.9	1.0
3326	Spring and wire product manufacturing	129	2,965	45,188	-1,757	-37.2	0.6	0.6
3327	Machine shops and threaded product mfg	2,671	41,736	53,122	3,243	8.4	1.0	1.1
3328	Coating, engraving, and heat treating metals	856	15,298	42,835	-5,054	-24.8	1.0	1.2
3329	Other fabricated metal product manufacturing	574	17,232	61,534	-3,398	-16.5	0.6	0.6
3331	Ag., construction, and mining machinery mfg	214	5,588	58,668	108	2.0	0.2	0.2
3332	Industrial machinery manufacturing	422	14,051	111,111	-4,233	-23.2	1.2	1.2
3333	Commercial and service industry machinery	342	10,206	81,689	-10,596	-50.9	1.0	1.4
3334	HVAC and commercial refrigeration equipment	214	5,167	57,765	-1,660	-24.3	0.4	0.4
3335	Metalworking machinery manufacturing	725	11,957	53,477	-1,392	-10.4	0.6	0.5
3336	Turbine / power transmission equipment mfg	102	7,115	97,799	718	11.2	0.6	0.6
3339	Other general purpose machinery mfg	635	16,679	68,777	-4,455	-21.1	0.6	0.6
3341	Computer and peripheral equipment mfg	454	60,833	203,931	-11,791	-16.2	3.4	2.5
3342	Communications equipment manufacturing	470	27,090	124,440	-7,011	-20.6	2.2	1.6
3343	Audio and video equipment manufacturing	134	6,546	94,183	-3,941	-37.6	2.8	2.2
3344	Semiconductor and electronic component mfg	1,399	88,818	113,778	-33,780	-27.6	2.0	2.0
3345	Electronic instrument manufacturing	1,250	81,603	107,669	-28,961	-26.2	1.8	2.1
3346	Magnetic media manufacturing / reproducing	140	5,386	161,856	-6,556	-54.9	2.3	1.9
3351	Electric lighting equipment manufacturing	253	6,769	56,066	-3,654	-35.1	1.3	1.3
3352	Household appliance manufacturing	50	1,429	52,357	-1,165	-44.9	0.2	0.2
3353	Electrical equipment manufacturing	292	8,428	62,764	-2,030	-19.4	0.5	0.5
3359	Other electrical equipment / component mfg	377	12,387	69,015	-3,664	-22.8	0.9	0.9
3361	Motor vehicle manufacturing	47	3,005	73,843	-5,513	-64.7	0.2	0.3
3362	Motor vehicle body and trailer manufacturing	151	4,554	41,684	-5,310	-53.8	0.3	0.6
3363	Motor vehicle parts manufacturing	488	12,335	47,295	-12,071	-49.5	0.2	0.3
3364	Aerospace product and parts manufacturing	588	70,482	97,003	-8,953	-11.3	1.3	1.5
3365	Railroad rolling stock manufacturing	12	790	99,756	116	17.2	0.3	0.3
3366	Ship and boat building	117	7,565	62,640	-1,524	-16.8	0.5	0.5
3369	Other transportation equipment manufacturing	161	3,200	57,032	-2,152	-40.2	0.9	1.2
3371	Household and institutional furniture mfg	1,519	20,325	37,329	-24,429	-54.6	0.8	1.0
3372	Office furniture and fixtures manufacturing	398	7,517	46,289	-7,887	-51.2	0.7	0.9
3379	Other furniture related product manufacturing	130	3,681	38,518	-3,735	-50.4	0.9	1.2
3391	Medical equipment / supplies manufacturing	1,680	53,331	77,408	3,423	6.9	1.5	1.4
3399	Other miscellaneous manufacturing	2,118	29,516	56,522	-14,127	-32.4	1.0	1.0
Total Manufacturing		39,763	1,245,938	77,346	-388,020	-23.7	0.9	0.9

List of Exhibits and Data Sources

Exhibit A-3
List of Exhibits and Data Sources

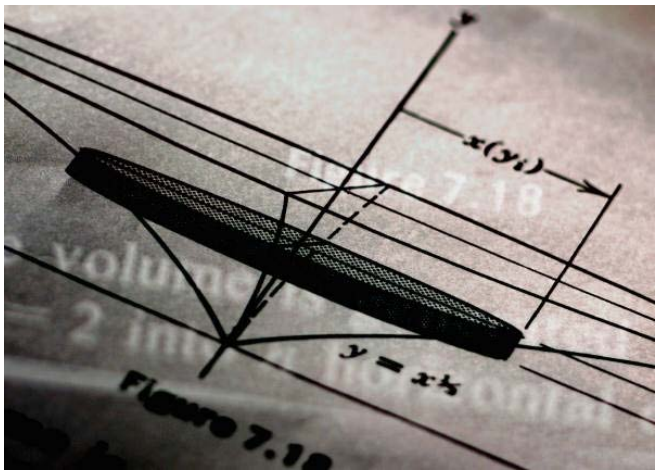
Exhibit A-3 (cont'd)

Exhibit A-3 (cont'd)

Description of Manufacturing Subsectors

The industry sectors used in this report are established by the North American Industry Classification System (NAICS). NAICS divides the economy into twenty sectors each of which has a number of subsectors, and groups industries within these subsectors according to production criteria.

Listed below is a short description of each of the twenty-one manufacturing subsectors as taken from the sourcebook, *North American Industry Classification System,* published by the U.S. Office of Management and Budget (2012). Listed following each subsector are the industry groups it contains. Although each industry group contains more refined industries, the four-digit level of significance is the highest level of refinement used in this report.



311 Food Manufacturing
Industries in this subsector transform livestock and agricultural products into products for intermediate or final consumption. These food products are typically sold to wholesalers or retailers for distribution to consumers, but establishments primarily engaged in retailing bakery and candy products made on the premises not for immediate consumption are also included.

Industry groups:
- 3111 Animal Food Manufacturing
- 3112 Grain and Oilseed Milling
- 3113 Sugar/Confectionery Products
- 3114 Fruit, Vegetable, & Specialty Foods
- 3115 Dairy Product Manufacturing
- 3116 Animal Slaughtering and Processing
- 3117 Seafood Product Preparation & Packaging
- 3118 Bakeries and Tortilla Manufacturing
- 3119 Other Food Manufacturing

312 Beverage and Tobacco Product Manufacturing
Industries in the Beverage and Tobacco Product Manufacturing subsector manufacture beverages and tobacco products. Ice manufacturing, although not a beverage, is included with beverage manufacturing because it uses the same production process as water purification.

Industry groups:
- 3121 Beverage Manufacturing
- 3122 Tobacco Manufacturing

313 Textile Mills
Establishments in the Textile Mills subsector transform a basic fiber (natural or synthetic) into a product, such as yarn or fabric that is further manufactured into usable items, such as apparel, sheets, towels, and textile bags for individual or industrial consumption. The further manufacturing may be performed in the same establishment and classified in this subsector, or it may be performed at a separate establishment and be classified elsewhere in manufacturing.

Industry groups:
- 3131 Fiber, Yarn, and Thread Mills
- 3132 Fabric Mills
- 3133 Textile and Fabric Finishing and Fabric

314 Textile Product Mills
Establishments in the Textile Product Mills subsector make textile products (except apparel). With a few exceptions, processes used in these industries are generally cut and sew (i.e., purchasing fabric and cutting and sewing to make nonapparel textile products, such as sheets and towels).

Industry groups:
- 3141 Textile Furnishings Mills
- 3149 Other Textile Product Mills

315 Apparel Manufacturing
Industries in the Apparel Manufacturing subsector group establishments with two distinct manufacturing processes: (1) cut and sew (i.e., purchasing fabric and cutting and sewing to make a garment), and (2) the manufacture of garments in establishments that first

knit fabric and then cut and sew the fabric into a garment. This subsector includes a diverse range of establishments manufacturing full lines of ready-to-wear apparel and custom apparel: apparel contractors, performing cutting or sewing operations on materials owned by others; jobbers performing entrepreneurial functions involved in apparel manufacture; and tailors, manufacturing custom garments for individual clients are all included.

Industry groups:
- 3151 Apparel Knitting Mills
- 3152 Cut and Sew Apparel Manufacturing
- 3159 Accessories and Other Apparel Mfg

316 Leather and Allied Product Manufacturing
Establishments in the Leather and Allied Product Manufacturing subsector transform hides into leather by tanning or curing and fabricating the leather into products for final consumption. It also includes the manufacture of similar products from other materials, including products (except apparel) made from "leather substitutes," such as rubber, plastics, or textiles because they are made in similar ways leather products are made and often in the same establishments. Rubber footwear, textile luggage, and plastics purses or wallets are examples of such products.

Industry groups:
- 3161 Leather and Hide Tanning and Finishing
- 3162 Footwear Manufacturing
- 3169 Other Leather Product Manufacturing

321 Wood Product Manufacturing
Industries in the Wood Product Manufacturing subsector manufacture wood products, such as lumber, plywood, veneers, wood containers, wood flooring, wood trusses, manufactured homes (i.e., mobile homes), and prefabricated wood buildings. Production processes include sawing, planing, shaping, laminating, and assembling of wood products starting from logs that are cut into bolts, or lumber that then may be further cut, or shaped by lathes or other shaping tools. The lumber or other transformed wood shapes may also be subsequently planed or smoothed, and assembled into finished products, such as wood containers. This subsector includes establishments that make wood products from logs and bolts that are sawed and shaped, and establishments that purchase sawed lumber and make wood products.

Industry groups:
- 3211 Sawmills and Wood Preservation
- 3212 Veneer and Engineered Wood Products
- 3219 Other Wood Product Manufacturing

322 Paper Manufacturing
Industries in the Paper Manufacturing subsector make pulp, paper, or converted paper products. The manufacturing of these products is grouped together because they constitute a series of vertically connected processes. More than one is often carried out in a single establishment. There are essentially three activities. The manufacturing of pulp involves separating the cellulose fibers from other impurities in wood or used paper. The manufacturing of paper involves matting these fibers into a sheet. Converted paper products are made from paper and other materials by various cutting and shaping techniques which include coating and laminating activities.

Industry groups:
- 3221 Pulp, Paper, and Paperboard Mills
- 3222 Converted Paper Product Manufacturing

323 Printing and Related Support Activities
Industries in the Printing and Related Support Activities subsector print products, such as newspapers, books, labels, business cards, stationery, business forms, and other materials, and perform support activities, such as data imaging, platemaking services, and bookbinding. The support activities included here are an integral part of the printing industry, and a product (a printing plate, a bound book, or a computer disk or file) that is an integral part of the printing industry is almost always provided by these operations. Processes used in printing include a variety of methods used to transfer an image from a plate, screen, film, or computer file to some medium, such as paper, plastics, metal, textile articles, or wood. The most prominent of these methods is to transfer the image from a plate or screen to the medium (lithographic, gravure, screen, and flexographic printing). A rapidly growing new technology uses a computer file to directly "drive" the printing mechanism to create the image and new electrostatic and other types of equipment (digital or nonimpact printing). Though printing and publishing are often carried out by the same enterprise (a newspaper, for example), it is less and less the case that these distinct activities are carried out in the same establishment. When publishing and printing are done in the same establishment, the establishment is classified in Sector 51 even if the receipts for printing exceed those for publishing. This subsector includes printing on clothing because the production process for that activity is printing, not clothing manufacturing. For instance, the printing of T-shirts is included in this subsector. In contrast, printing on fabric (or grey goods) is not included here but is included in the NAICS Industry 31331.

Industry groups:
- 3231 Printing and Related Support Activities

324 Petroleum and Coal Products Manufacturing
The Petroleum and Coal Products Manufacturing subsector is based on the transformation of crude petroleum and coal into usable products. The dominant process is petroleum refining that involves the separation of crude petroleum into component products through such techniques as cracking and distillation. In addition, this subsector includes establishments that primarily further process refined petroleum and coal products and produce products, such as asphalt coatings and petroleum lubricating oils. Establishments that manufacture petrochemicals from refined petroleum are classified in Industry 32511.

Industry groups:
- 3241 Petroleum & Coal Products Manufacturing

325 Chemical Manufacturing
The Chemical Manufacturing subsector is based on the transformation of organic and inorganic raw materials by a chemical process and the formulation of products. This subsector does not include all industries transforming raw materials by a chemical process. It is common for some chemical processing to occur during mining operations. These beneficiating operations, such as copper concentrating, are classified in Sector 21, Mining, Quarrying, and Oil and Gas Extraction. Also, the refining of crude petroleum is included in Subsector 324, the manufacturing of aluminum oxide is included in Subsector 331, and beverage distilleries are classified in Subsector 312.

Industry groups:
- 3251 Basic Chemical Manufacturing
- 3252 Resin, Rubber and Synthetic Fibers and Filaments Mfg
- 3253 Agricultural Chemical Manufacturing
- 3254 Pharmaceutical & Medicine Manufacturing
- 3255 Paint, Coating, & Adhesive Manufacturing
- 3256 Cleaning Compound and Toiletry Manufacturing
- 3259 Other Chemical Preparation Manufacturing

326 Plastics and Rubber Products Manufacturing
Industries in the Plastics and Rubber Products Manufacturing subsector make goods by processing plastics materials and raw rubber. The core technology employed by establishments in this subsector is that of plastics or rubber product production. Plastics and rubber are combined in the same subsector because plastics are increasingly being used as a substitute for rubber; however the subsector is generally restricted to the production of products made of just one material, either solely plastics or rubber. Within the Plastics and Rubber Products Manufacturing subsector, a distinction is made between plastics and rubber products at the industry group level, although it is not a rigid distinction. As materials technology progresses, plastics are increasingly being used as a substitute for rubber; and eventually, the distinction may disappear as a basis for establishment classification. In keeping with the core technology focus of plastics, lamination of plastics film to plastics film as well as the production of bags from plastics only is classified in this subsector.

Industry groups:
- 3261 Plastics Product Manufacturing
- 3262 Rubber Product Manufacturing

327 Nonmetallic Mineral Product Manufacturing
The Nonmetallic Mineral Product Manufacturing subsector transforms mined or quarried nonmetallic minerals, such as sand, gravel, stone, clay, and refractory materials, into products for intermediate or final consumption. Processes used include grinding, mixing, cutting, shaping, and honing. Heat often is used in the process and chemicals are frequently mixed to change the composition, purity, and chemical properties for the intended product. For example, glass is produced by heating silica sand to the melting point (sometimes combined with cullet or recycled glass) and then drawn, floated, or blow molded to the desired shape or thickness. Refractory materials are heated and then formed into bricks or other shapes for use in industrial applications. This subsector includes establishments that manufacture products, such as bricks, refractories, ceramic products, and glass and glass products, such as plate glass and containers. Also included are cement and concrete products, lime, gypsum and other nonmetallic mineral products including abrasive products, ceramic plumbing fixtures, statuary, cut stone products, and mineral wool. The products are used in a wide range of activities from construction and heavy and light manufacturing to articles for personal use. Excluded from the subsector are establishments that primarily beneficiate mined nonmetallic minerals. Beneficiation is the process whereby the extracted material is reduced to particles that can be separated into mineral and waste, the former suitable for further processing or direct use. Beneficiation establishments are included in Sector 21, Mining, Quarrying, and Oil and Gas Extraction.

Industry groups:
- 3271 Clay Product & Refractory Manufacturing
- 3272 Glass and Glass Product Manufacturing
- 3273 Cement & Concrete Product Manufacturing
- 3274 Lime and Gypsum Product Manufacturing

- 3279 Other Nonmetallic Mineral Product Manufacturing

331 Primary Metal Manufacturing

Industries in the Primary Metal Manufacturing subsector smelt and/or refine ferrous and nonferrous metals from ore, pig or scrap, using electrometallurgical and other process metallurgical techniques. Establishments in this subsector also manufacture metal alloys and superalloys by introducing other chemical elements to pure metals. The output of smelting and refining, usually in ingot form, is used in rolling, drawing, and extruding operations to make sheet, strip, bar, rod, or wire, and in molten form to make castings and other basic metal products. Primary manufacturing of ferrous and nonferrous metals begins with ore or concentrate as the primary input. Establishments manufacturing primary metals from ore and/or concentrate remain classified in the primary smelting, primary refining, or iron and steel mill industries regardless of the form of their output. Establishments primarily engaged in secondary smelting and/or secondary refining recover ferrous and nonferrous metals from scrap and/or dross. The output of the secondary smelting and/or secondary refining industries is limited to shapes, such as ingot or billet, which will be further processed. Recovery of metals from scrap often occurs in establishments that are primarily engaged in activities, such as rolling, drawing, extruding, or similar processes. Excluded from the subsector are establishments primarily engaged in manufacturing ferrous and nonferrous forgings (except ferrous forgings made in steel mills) and stampings. Although forging, stamping, and casting are all methods used to make metal shapes, forging and stamping do not use molten metals and are included in Subsector 332, and establishments primarily engaged in operating coke ovens are classified in Industry 32419.

Industry groups:

- 3311 Iron and Steel Mills and Ferroalloys Manufacturing
- 3312 Steel Product Manufacturing from Purchased Steel
- 3313 Alumina and Aluminum Production
- 3314 Other Nonferrous Metal Production
- 3315 Foundries

332 Fabricated Metal Product Manufacturing

Industries in the Fabricated Metal Product Manufacturing subsector transform metal into intermediate or end products, other than machinery, computers and electronics, and metal furniture, or treat metals and metal formed products fabricated elsewhere. Important fabricated metal processes are forging, stamping, bending, forming, and machining, used to shape individual pieces of metal; and other processes, such as welding and assembling, used to join separate parts together. Establishments in this subsector may use one of these processes or a combination of these processes. The manufacturing performed in this subsector begins with manufactured metal shapes. The establishments in this subsector further fabricate the purchased metal shapes into a product. For instance, the Spring and Wire Product Manufacturing industry starts with wire and fabricates such items. Within manufacturing there are other establishments that make the same products made by this subsector; only these establishments begin production further back in the production process. These establishments have a more integrated operation. For instance, one establishment may manufacture steel, draw it into wire, and make wire products in the same establishment. Such operations are classified in the Primary Metal Manufacturing subsector.

Industry groups:

- 3321 Forging and Stamping
- 3322 Cutlery and Handtool Manufacturing
- 3323 Architectural and Structural Metals
- 3324 Boilers, Tanks, and Shipping Containers
- 3325 Hardware Manufacturing
- 3326 Spring and Wire Product Manufacturing
- 3327 Machine Shops and Threaded Products
- 3328 Coating, Engraving & Heat Treating Metal
- 3329 Other Fabricated Metal Product Manufacturing

333 Machinery Manufacturing

Industries in the Machinery Manufacturing subsector create end products that apply mechanical force, for example, the application of gears and levers, to perform work. Some important processes for the manufacture of machinery are forging, stamping, bending, forming, and machining that are used to shape individual pieces of metal. Processes, such as welding and assembling are used to join separate parts together. Although these processes are similar to those used in metal fabricating establishments, machinery manufacturing is different because it typically employs multiple metal forming processes in manufacturing the various parts of the machine. Moreover, complex assembly operations are an inherent part of the production process.

Industry groups:

- 3331 Agriculture, Construction & Mining Machinery
- 3332 Industrial Machinery Manufacturing
- 3333 Commercial & Service Industry Machinery
- 3334 HVAC and Commercial Refrigeration Equipment
- 3335 Metalworking Machinery Manufacturing
- 3336 Turbine and Power Transmission Equipment

- 3339 Other General Purpose Machinery Manufacturing

334 Computer and Electronic Product Manufacturing

Establishments in the Computer and Electronic Product Manufacturing subsector manufacture computers, computer peripherals, communications equipment, and similar electronic products, and components for such products. The Computer and Electronic Product Manufacturing industries have been combined in the hierarchy of NAICS because of the economic significance they have attained. Their rapid growth suggests that they will become even more important in the future, and in addition their manufacturing processes are fundamentally different from the manufacturing processes of other machinery and equipment. The design and use of integrated circuits and the application of highly specialized miniaturization technologies are common elements in the production technologies of the computer and electronic subsector. Convergence of technology motivates this NAICS subsector. Digitalization of sound recording, for example, causes both the medium (the compact disc) and the equipment to resemble the technologies for recording, storing, transmitting, and manipulating data. Communications technology and equipment have been converging with computer technology. When technologically-related components are in the same sector, it makes it easier to adjust the classification for future changes, without needing to redefine its basic structure. The creation of the Computer and Electronic Product Manufacturing subsector assists in delineating new and emerging industries because the activities that will serve as the probable sources of new industries, such as computer manufacturing and communications equipment manufacturing, or computers and audio equipment, are brought together. As new activities emerge, they are less likely therefore, to cross the subsector boundaries of the classification.

Industry groups:

- 3341 Computers and Peripheral Equipment
- 3342 Communications Equipment Manufacturing
- 3343 Audio and Video Equipment Manufacturing
- 3344 Semiconductor and Electronic Components
- 3345 Electronic Instrument Manufacturing
- 3346 Magnetic Media Manufacture &Reproducing

335 Electrical Equipment, Appliance, and Component Manufacturing

Industries in the Electrical Equipment, Appliance, and Component Manufacturing subsector manufacture products that generate, distribute and use electrical power. Electric Lighting Equipment Manufacturing establishments produce electric lamp bulbs, lighting fixtures, and parts. Household Appliance Manufacturing establishments make both small and major electrical appliances and parts. Electrical Equipment Manufacturing establishments make goods, such as electric motors, generators, transformers, and switchgear apparatus. 0ther Electrical Equipment and Component Manufacturing establishments make devices for storing electrical power (e.g., batteries), for transmitting electricity (e.g., insulated wire), and wiring devices (e.g., electrical outlets, fuse boxes, and light switches).

Industry groups:

- 3351 Electric Lighting Equipment Manufacturing
- 3352 Household Appliance Manufacturing
- 3353 Electrical Equipment Manufacturing
- 3359 Other Electrical Equipment & Components

336 Transportation Equipment Manufacturing

Industries in the Transportation Equipment Manufacturing subsector produce equipment for transporting people and goods. Transportation equipment is a type of machinery. An entire subsector is devoted to this activity because of the significance of its economic size in all three North American countries. Establishments in this subsector utilize production processes similar to those of other machinery manufacturing establishments - bending, forming, welding, machining, and assembling metal or plastic parts into components and finished products. However, the assembly of components and subassemblies and their further assembly into finished vehicles tend to be a more common production process in this subsector than in the Machinery Manufacturing subsector. NAICS has industry groups for the manufacture of equipment for each mode of transport - road, rail, air and water. Parts for motor vehicles warrant a separate industry group because of their importance and because parts manufacture requires less assembly, and the establishments that manufacture only parts are not as vertically integrated as those that make complete vehicles. Land use motor vehicle equipment not designed for highway operation (e.g., agricultural equipment, construction equipment, and materials handling equipment) is classified in the appropriate NAICS subsector based on the type and use of the equipment.

Industry groups:

- 3361 Motor Vehicle Manufacturing
- 3362 Motor Vehicle Body & Trailer Manufacturing
- 3363 Motor Vehicle Parts Manufacturing
- 3364 Aerospace Product & Parts Manufacturing

- 3365 Railroad Rolling Stock Manufacturing
- 3366 Ship and Boat Building
- 3369 Other Transportation Equipment Manufacturing

337 Furniture and Related Product Manufacturing

Industries in the Furniture and Related Product Manufacturing subsector make furniture and related articles, such as mattresses, window blinds, cabinets, and fixtures. The processes used in the manufacture of furniture include the cutting, bending, molding, laminating, and assembly of such materials as wood, metal, glass, plastics, and rattan. However, the production process for furniture is not solely bending metal, cutting and shaping wood, or extruding and molding plastics. Design and fashion trends play an important part in the production of furniture. The integrated design of the article for both esthetic and functional qualities is also a major part of the process of manufacturing furniture. Design services may be performed by the furniture establishment's work force or may be purchased from industrial designers.

Industry groups:

- 3371 Household and Institutional Furniture
- 3372 Office Furniture and Fixtures Manufacturing
- 3379 Other Furniture Related Products

339 Miscellaneous Manufacturing

Industries in the Miscellaneous Manufacturing subsector make a wide range of products that cannot readily be classified in specific NAICS subsectors in manufacturing. Processes used by these establishments vary significantly, both among and within industries. For example, a variety of manufacturing processes are used in manufacturing sporting and athletic goods that include products such as tennis racquets and golf balls. The processes for these products differ from each other, and the processes differ significantly from the fabrication processes used in making dolls or toys, the melting and shaping of precious metals to make jewelry, and the bending, forming, and assembly used in making medical products. The industries in this subsector are defined by what is made rather than how it is made. Although individual establishments might be appropriately classified elsewhere in the NAICS structure, for historical continuity, these product-based industries were maintained. In most cases, no one process or material predominates for an industry.

Industry groups:

- 3391 Medical Equipment & Supplies Manufacturing
- 3399 Other Miscellaneous Manufacturing

Study Authors

Christine Cooper, Ph.D.
Vice President, Institute for Applied Economics

Dr. Cooper leads the LAEDC Institute for Applied Economics whose work involves research in regional issues such as economic impact studies, regional industry analysis and forecasts, workforce development analysis and policy studies. Her fields of expertise include development economics, environmental economics, regional analysis and urban sustainability.

Prior to joining the LAEDC, Dr. Cooper was co-founder of a start-up company in Hong Kong concentrating on equity transactions software and computer accessories manufacturing, which expanded production into the special economic zone of Shenzhen, China and distributed products throughout the United States and Asia. With her business partner, she also established the first authorized Apple Computer retailer in China. She has been a lecturer at California State University, Long Beach and at the Pepperdine Graziadio School of Business and Management.

Dr. Cooper is a citizen of the United States and Canada. She earned a Bachelor of Arts in Economics from Carleton University in Ottawa, Canada, and a Ph.D. in Economics from the University of Southern California. With funding from the National Science Foundation, she earned a Graduate Certificate in Environmental Sciences, Policy and Engineering. Her current research includes industry cluster performance in the regional economy, commuting and job allocation patterns and workforce development issues.

Shannon M. Sedgwick
Economist

In her current capacity as an Economist at the LAEDC, Ms. Sedgwick develops subject-specific information and data interpretation for economic impact, demographic, transportation, industry and issue studies. She performs research, data collection and organization, analysis and report preparation. Her work focuses on demographics, industry clusters and occupational analysis. Ms. Sedgwick is also proficient at conducting geospatial analysis and has experience working with IMPLAN.

Ms. Sedgwick joined the LAEDC team in June of 2008 as an Economic Research Assistant with the Kyser Center for Economic Research. In that role she assisted both Economic Research and the Consulting Practice of the LAEDC with data collection and research, managing multiple data sets covering the State of California, Southern California and its counties. She was responsible for the *Business Scan* a collection of Los Angeles County economic indicators; the annual *L.A. Stats*, the most frequently requested statistics for Los Angeles region; and was a regular contributor to the weekly economic newsletter, *e-Edge.*

Before joining the LAEDC, Ms. Sedgwick managed an industrial and steel supply company located in the Inland Empire. There she identified and targeted a diverse customer base, and analyzed product and customer patterns in the local industrial market to successfully increase revenues.

A Southern California native, Ms. Sedgwick received her Bachelor of Arts in Economics from the University of Southern California (USC) with a minor in Architecture. She has been a member of the national and the Los Angeles Chapter of the National Association for Business Economics (NABE) since 2008.

Somjita Mitra, Ph.D.
Economist

Somjita Mitra joined the LAEDC Institute for Applied Economics as an Economist in June 2013. She is involved in planning, designing and conducting research and analysis for consulting clients and local businesses and governments, as well as for LAEDC's internal departments. Her focus is in regional analysis, economic impact studies and the industrial and occupational structure of local economies.

Before joining the LAEDC, Dr. Mitra was an Economist for a local economic research and litigation consulting company evaluating economic damages, estimating lost profits, identifying key economic issues and developing necessary analytical and empirical frameworks. Prior to this, Dr. Mitra was Project Director for a consumer research firm in Los Angeles where she managed projects that identified and analyzed key market issues for local firms as well as multinational corporations.

Dr. Mitra received her Bachelor of Arts in Economics and Political Science from the University of California, Los Angeles and her Master of Arts in Politics, Economics and Business as well as her Ph.D. in Economics from Claremont Graduate University. Dr. Mitra enjoys volunteering in the local community and is actively involved in both women's welfare and animal rescue organizations. ❖

INSTITUTE FOR APPLIED ECONOMICS
Los Angeles County Economic Development Corporation
444 S. Flower Street, 37th Floor
Los Angeles, CA 90071